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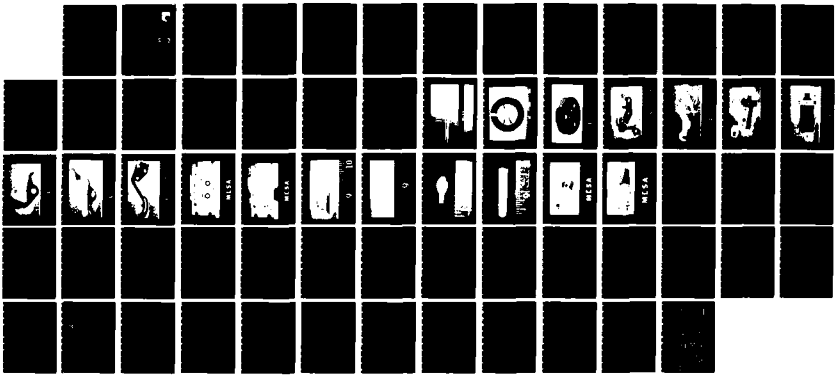

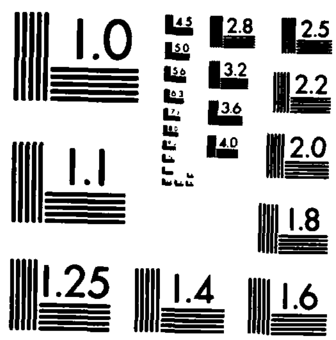

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DETERMINATION OF SELECTED PROPERTIES OF TELETYPE PARTS

Neal R. Ontko

Materials Engineering Branch
Systems Support Division

October 1985

Final Report for Period March - December 1984

Approved for public release; distribution unlimited.

MATERIALS LABORATORY
AIR FORCE WRIGHT AERONAUTICAL LABORATORIES
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

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This technical report has been reviewed and is approved for publication.

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Selected properties for materials used in the fabrication of the teletype parts supplied by DESC were determined. These properties (hardness, surface roughness, and chemical composition) will be used to convert procurement of these parts from sole source to multi-source. Cost savings have been established through prior efforts conducted by DESC/SV and AFWAL/MLSE. Keywords: — (Defense Electronic Supply Center)

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PREFACE

This report was prepared by the Materials Engineering Branch (AFWAL/MLSE), Systems Support Division, Materials Laboratory, Air Force Wright Aeronautical Laboratories, Wright-Patterson Air Force Base, Ohio.

Funds for this effort were provided by the Defense Electronic Supply Center (DESC) under program element DESC 8402, "Determination of Selected Properties of Teletype Parts."

The work reported herein was performed during the period March 1983 to December 1984 under the direction of the author, Neal R. Ontko (AFWAL/MLSE). The report was released by the author in December 1984.

The author wishes to acknowledge and thank the following people for their contributions: Mr J. Muntz (AFWAL/MLSE), Mr R. Williams (AFWAL/MLSE), Mr G. Saul (AFWAL/MLSE), Mr T. Dusz (UDRI), Mr J. Workman (Tech Services Group), and personnel from the 4950th/TW/AMCQ-B and 4950th/TW/RMPP.

TABLE OF CONTENTS

SECTION		PAGE
I	BACKGROUND	1
II	DETAILS OF WORK PERFORMED	2
III	MATERIALS CHARACTERIZATION DISCUSSION	9
APPENDIX	HISTORY OF PRIOR EFFORTS	35

LIST OF ILLUSTRATIONS

FIGURE		PAGE
1	Shaft, Shouldered	13
2a	Gear (front)	14
2b	Gear (edge)	15
3	Link	16
4	Lever	17
5a	Armature Assembly (front)	18
5b	Armature Assembly (back)	19
6a	Latch, Lever (front)	20
6b	Latch, Lever (back)	21
7	Bail	22
8a	Panel-Radio (front)	23
8b	Panel-Radio (back)	24
8c	Panel-Radio (lens, front)	25
8d	Panel-Radio (lens, edge)	26
9	Head	27
10	Contact	28
11a	Contact (front, top)	29
11b	Contact (back, bottom)	30

LIST OF TABLES

TABLE		PAGE
1.	List of Individual Parts	3
2a	Alloy Composition/Identification	5
2b	Suggested Materials for Part Fabrication	7
3	Hardness and Surface Roughness Values	8
4	Alloy Steel Composition Ranges and Limits - Bars, Blooms, Billets, and Slabs	31
5	Alloy Steel Heat Composition Ranges and Limits - Plate	32
6a	Carbon Steel Product Composition Tolerances	32
6b	Carbon Steel Composition Ranges and Limits - Structural Shapes, Plate, Strip, Sheet, and Welded Tubing	33
6c	Carbon Steel Composition Ranges and Limits - Semifinished Products for Forging, Hot Rolled and Cold Finished Bars, Wire Rod and Seamless Tubing	33
7	Alloy Steel Product Composition Tolerances-Bars, Billets, Blooms, Slabs	34
8	Alloy Steel Product Composition Tolerances - Plate	34

SECTION I
BACKGROUND

Several thousand replacement parts for MK-28 mechanical teletypes are ordered by the Defense Electronics Supply Center (DESC) each year. These older teletypes, currently being phased out by newer MK-48 models, are used by the Department of Defense agencies worldwide. Each of the parts investigated in this effort are at present sole source procurement items. To reduce costs, an effort was initiated by DESC/SV (Value Engineering Group), Dayton, Ohio to convert these sole source procurement items to multi-source competitive procurement actions. The Materials Engineering Branch of the Systems Support Division, Materials Laboratory, Air Force Wright Aeronautical Laboratories was requested to identify the alloys or materials used to fabricate the original parts or components and obtain surface roughness and mechanical hardness values. Photographs were taken to illustrate relative size and to depict specific component geometries. Individual part drawings will be prepared by DESC.

Our objective was to characterize the materials for each teletype part submitted, thus enabling DESC to successfully obtain competitive bids on parts made from previously unknown materials. Substantial cost reductions were achieved in a prior Materials Laboratory effort which resulted in approximately $283,900 in savings over a two-year time period for a Zinc "dashpot," stock number 5815-00-370-0881 (See Appendix).

This report will serve as the end-product of this effort. No conclusions or further recommendations other than those found in the text are offered.

SECTION II

DETAILS OF WORK PERFORMED

A chemical analysis of materials for the 11 parts submitted was performed in-house by the Analytical Group of the Materials Integrity Branch, AFWAL/MLSA. Surface roughness measurements were obtained by the Quality Assurance Group of the mechanical test wing's Machine Branch, 4950th/TW/AMCQ-B. Photographic documentation and hardness values were generated by the Structural and Electronic Failure Analysis personnel of the Materials Integrity Branch, AFWAL/MLSE and the Processing Branch of the Technical Photo Division, 4950th/TW/RMPP.

Overall coordination, supervision, and alloy identification of specific alloys was performed by the Engineering and Design Data Group of the Materials Engineering Branch. A complete list of the parts submitted is presented in Table 1. Chemical composition by major alloying elements for each component part and identification of potential candidate materials is shown in Table 2a. Potential materials from Table 2a are narrowed down to those suggested for use in Table 2b. Hardness values and surface roughness indications are recorded in Table 3. No attempt was made to study microstructure or identify a specific temper or heat treat for the material investigated.

TABLE 1

LIST OF INDIVIDUAL PARTS

1 5815-00-370-1483
FSCM 57712 MFR P/N 152447
Shaft, Shouldered
DLA 900-83-C-0938

2. 5815-00-738-1797
163459
Gear
Level-A-1982

3. 5815-00-091-9581
57712 P/N 153175 IAW
59433 DWG #153175
Link
DLA 900-82-C-0321

4. 5815-00-370-1467
P/N 152407
Lever

5. 5815-00-104-0398
P/N 319220
Armature Assembly
DLA 900-82-C-3773

6. 5815-00-370-1475
FSCM-57712 P/N 152427
Latch, Lever
DLA 900-82-M-QA92

7. 5815-00-370-1479
57712 P/N 152438 IAW
59433 DWG # 152438
Bail
DLA 900-79-C-1524

8. 5821-00-944-3437
Panel - Radio

9. 5815-00-409-2569
196094
Head
Level - A - 1983 MOK

10. 5999-201-4408
P/N NX1004
Contact

11. 5999-00-560-7123
    P/N 6203979G1
    Contact
    N00104-77-A-0113-UD03

TABLE 2a

ALLOY COMPOSITION/IDENTIFICATION

Sample	Alloy ID	C	Mn	Si	Cr	Ni	Mo	Pb	Cu	Other
1*		.49/.50	.69/.85	N.D./.26	.83/.94	N.D./.31	.17/.19	.18/.21	N.D./.20	
	4150	.48/.53	.75/1.00	.15/.30	.80/1.10		.15/.25			
2 A										(Nylon 66)
2 B	[Alum Base]	N.D.	N.D.	.11	N.D.	N.D.	N.D.	.30	4.50	(Bi .30)(Fe .20)
	2011 Alum							.40	5.5	(Bi .40)(Al 93.7)
3 A/H**		.37/.30	.45/.46	.23/.23	.74/.72	.49/.40	.14/.12	N.D./N.D.	.10/.13	(N.D./Sn-Trace)
	4130	.28/.33	.40/.60	.15/.30	.80/1.10		.15/.25			
	4135	.33/.38	.70/.90	.15/.30	.30/1.10		.15/.25			
	8637	.35/.40	.75/1.00	.15/.30	.40/.60	.40/.70	.15/.25			
B,C,D		.31/.33	1.0/1.1	N.D.	N.D.	.30/.49	N.D./.03	.17/.27		
	10L30	.28/.34	.60/.90							
	10L33	.29/.36	.70/1.00							
E/F		.16/.19	.96/.97	N.D.	N.D.	.26/.39	N.D.	.18/.25		
	10L19	.15/.20	.70/1.00							
	10L22	.18/.23	.70/1.00							
G		.15	.81	N.D.	N.D.	N.D.	N.D.	.20	.06	(Zn 1.5)
	10L16	.13/.18	.60/.90							
	10L18	.15/.20	.60/.90							
	10L19	.15/.20	.70/1.00							
4		.17	.68	.28	.47	.57	.12	N.D.	.01	
	4118	.18/.23	.70/.90	.15/.30	.40/.60		.08/.15			
	8115	.13/.18	.70/.90	.15/.30	.30/.50	.20/.40	.08/.15			
5 A		.96	.32	.26	N.D.	N.D.	.03	N.D.	N.D.	
	1095	.90/1.03	.30/.50							
B	[Copper Base]	N.D.	N.D.	.13	N.D.	N.D.	N.D.	N.D.	(Rem)	(Be 1.8)
	C 17200								(Rem)	(Be 1.8/2.0)
C		.01	.14	.30	N.D.	.44	.04	N.D.	.23	
	1005	.06 Max	.35 Max							
D		.20	.96	N.D.	N.D.	.74	N.D.	.31	.31	
	10L22	.18/.23	.70/1.00							

TABLE 2a - Continued

ALLOY COMPOSITION/IDENTIFICATION

Sample	Alloy ID	C	Mn	Si	Cr	Ni	Mo	Pb	Cu	Other
6 A		.18	.71	.25	.45	1.80	.13	N.D.	.58	
	4320	.17/.22	.45/.65	.15/.30	.40/.60	1.65/2.00	.20/.30			
B		.22	.71	.23	N.D.	.36	N.D.	N.D.	.52	
	1021	.18/.23	.60/.90							
	1022	.18/.23	.70/1.00							
	1026	.22/.28	.60/.90							
7		.22	.73	N.D.	.45	1.20	.14	N.D.	.26	
	4720	.17/.22	.50/.70	.15/.30	.35/.55	.90/1.20	.15/.25			
8 A	[Plexiglass]									
B	[Lexan 141]									
9		.86	1.20	.35	.47	N.D.	N.D.	N.D.	N.D.	(V. 19)(W. 69)
	AISI 0-1	.85/1.00	1.00/1.40	.50Max	.40/.60					(V .30 max)(W.40/.60)
10	[Copper Base]	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	1.00	(Rem)	
	C 18700							.80/1.50	(Rem)	
11A	Copper Wire(Tin Coated)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.		
B	[Copper Base]	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	(Rem)	
	C 10100								(99.99)	
C,F	[Silver Base]	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	(Trace)	
D		.15	.41	.26	N.D.	N.D.	N.D	N.D.		
	1012	.10/.15	.30/.60							
	1015	.13/.18	.30/.60							
	1017	.15/.20	.30/.60							
E***	[Silver Base]	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	15.1	(Cd 14.6, Zn 10.1)
BAg-1A	[Ag Base]								18.0	(Cd 16.5, Zn 15.5)
BAg-3	[Ag Base]								16.0	(Cd 15.5, Zn 15.5)

* Two separate samples (points) are shown as .xx/.xx for part 1 only.

** Data shown .xx/.xx is for two points such as A/H or E/F and for the high and low where three points B,C,D appear.

*** Specification shown for BAg-1a and BAg-3 are nominal compositions for these silver based (50.0%) filler materials.

TABLE 2b

SUGGESTED MATERIALS FOR PART FABRICATION

Part			Material (Alloy)
1.	Shaft, shouldered	AISI-SAE	4150
2.	Gear		
	A.		Nylon 66
	B.	AISI-SAE	2011
3.	Link		
	A./H.	AISI-SAE	4130
	B./C./D.		10L30
	E./F.		10L19
	G.		10L16
4.	Lever	AISI-SAE	4118
5.	Armature Assembly		
	A.	AISI-SAE	1095
	B.	UNS	C 17200
	C.	AISI-SAE	1005
	D.		10L22
6.	Latch, Lever		
	A.	AISI-SAE	4320
	B.		1022
7.	Bail	AISI-SAE	4720
8.	Panel-Radio		
	A.		Plexiglass
	B.		Lexan 141
9.	Head	AISI	0-1
10.	Contact	UNS	C 18700
11.	Contact		
	A.		Tin Coated Copper Wire
	B.	UNS	C 10100
	C./F.		Silver
	D.	AISI-SAE	1015
	E.		BAg - 1a

TABLE 3

HARDNESS AND SURFACE ROUGHNESS VALUES

	Part	Hardness	Surface Roughness [1]
1.	Shaft	R_B 97	4 - 12
2.	Gear		
	metal	R_B 68	23
	plastic [2]	16-18	40 - 50
3.	Link		
	left half	R_C 47	10
	right half	R_C 43	17
	bushing, connector	R_C 47	NA
	pins	R_B 93	NA
	rollers	R_B 93	NA
4.	Lever	R_C 44	12
5.	Armature Assembly		
	main body	R_B 92	22 - 30
	copper contact	R_C 33	NA
	black tab	R_B 88	NA
	steel rivets	R_C 28	NA
6.	Latch, Lever	R_C 46	37
7.	Bail	R_C 45	33 - 53
8.	Panel-Radio [2]		
	main panel	35 - 50	NA
	lens	10 - 20	NA
9.	Head	R_C 61	NA
10.	Contact	R_B 62	NA
11.	Contact		
	base	R_A 96 [3]	33 - 50
	contact	R_A 75 - 85 [3]	NA
	pin	R_B 90	NA

[1] Values shown are RA or Random Average which is similar but not the same as RMS values.

[2] Barber-Coleman "Barcol" hardness.

[3] Hardness readings of R_A indicate a very soft material but are not reliable.

SECTION III

MATERIALS CHARACTERIZATION DISCUSSION

The following paragraphs define or characterize the materials used for production of submitted teletype parts. In several instances the alloy or materials identified by chemical analysis of alloying elements or with infrared spectrometry fell within tolerance bands for more than one specific alloy. Several tables listing composition ranges and limits (taken from the Ninth Edition "Metals Handbook" published by the American Society for Metals) are presented as Tables 4-7. All of the items listed in Tables 2a and 2b are iron base alloys and use AISI-SAE designations unless otherwise noted.

1. SHAFT, SHOULDERED

The shouldered shaft was identified as 4150 alloy steel. When compared with the registered chemistry shown, one of two samples tested was found to be slightly low in Mn with no detectable Si content. The surface of the shaft was probably polished but had no detectable coating or plate.

2. GEAR

The plastic component for the gear was identified as Nylon 66 and the knurled metal disc or inner component as 2011 aluminum. Test results were somewhat low for the required 2011 alloying elements but this was the only reasonable candidate found. The knurled surface of the aluminum piece (edge only) was treated with a chromate conversion coating.

3. LINK

The two hinged components of the link (shown as Parts A and H in Figure 3) were fabricated from either 4130 or 4135 alloy steel. Carbon content for Part A fell within limits for 4135 however, the amount of Mn present is approximately half that required. The carbon and Mn content for Part H was within limits for 4130 but slightly low for Cr. Other elements shown were within the range and allowable limits set for alloy steels. A third possibility would be an 8637 alloy steel which does specify the Ni content found in the sample tested. Either 4130 or 4135 should be acceptable as the selected material. Part A was nickel plated while Part H indicated tin over copper as the surface coating.

Component parts which appear to be bushings (Parts B and D) and the hinge pin or peg (Part C) were made from a plain carbon steel. Two candidate materials identified and loosely matching in chemistry are 10L30 and 10L33. Although the Mn content was within specifications for 10L33, consideration should be given to 10L30 as it is probably more readily available. Part B was nickel plated.

Pins (Parts E and F) for the two rollers (Parts G, only one tested) were identified as either 10L19 or 10L22, both plain carbon steels. The two rollers were probably fabricated from either 10L16, 10L18, or 10L19, also plain carbon steels. Parts C, D, E, F, and G were not checked for coatings as sufficient material was not available. It is our suggestion that these parts also be nickel plated.

NOTE: Although the lead content found is within acceptable limits for plain carbon steels; 1030, 1033, 1019, etc., the letter "L" is inserted in the designation 10L30, 10L33, 10L19, etc., to identify "leaded" steels typically containing 0.15 to 0.35% lead.

4. LEVER

The lever was probably stamped from 4118 alloy steel, although the chemistry for the part supplied was slightly low in C and Mn. An alternate could be SAE standard grade 8115 again slightly low in Mn but higher than specified allowances for Ni. The part appears to have been "black oxide" coated.

5. ARMATURE ASSEMBLY

The armature assembly was divided into four components. The four rivets used to assemble the part were not analyzed in detail although they are known to be brass.

The black colored tab (Part A) was identified as a 1095 plain carbon steel. The black colored strap on the opposite side is assumed to be made from identical material. Both pieces were "black oxide" coated.

Two copper tangs (actually one piece Part B) fabricated from UNS C 17200 "beryllium copper" contain Be as the only major alloying element. No coating was evident.

The main body or base (Part C) was made from 1005 plain carbon steel and coated with electrolytic nickel plate.

The material for the stud or button (Part D) was characterized as 10L22 plain carbon steel with nickel plate.

6. LATCH, LEVER

The main piece or body (Part A) was fabricated from a 4320 alloy steel. The bushing or center component (Part B) could be any of three plain carbon steels, 1021, 1022, or 1026. Based on carbon content, 1022 seems best suited as a candidate material. Both parts gave indications of nickel plating.

7. BAIL

The one piece bail was characterized as nickel plated 4720 alloy steel slightly high in Mn.

8. PANEL-RADIO

The flat panel supplied was identified as a "plexiglass" type polymer and the curved lens as "Lexan 141." Both black and white coatings were characterized by Infrared analysis as polyamides. The principal element detected was silicon for the black coating and titanium for the white. The two elements probably take the form of silicon dioxide and titanium dioxide in the coatings. The panel appears to have a clear top coat, also a polyamide, over the black coating on the front face only. A detailed discussion and sketch of the coatings and their apparent application may be found in the appendix. It is strongly urged that the appendix section be carefully studied before final part drawings are released for procurement.

9. HEAD

The head was machined from AISI 0-1. No SAE or AISI designation could be found for this material. This particular piece had a copper coating over nickel flash on the base metal.

10. CONTACT

This contact appeared to have been machined from a single piece (bar) of an almost pure copper base alloy. UNS C 18700 "free machining copper" matched the chemistry for this part.

11. CONTACT

This contact was primarily a soldered or brazed assembly of six components. A braided wire (Part A) appears to be secured to the main bus or body (Part B) by a type of arc welding or single impulse of current (heat). The braided wire itself is tin coated copper. No further identification was attempted.

The base is essentially pure copper closely matching UNS C 10100 "oxygen-free electronic copper." It is entirely possible that a less expensive copper or copper alloy may adequately perform the task this assembly is required to do.

The contact (Part C) and coating (Part F) on the base were "commercially pure silver" with a trace of copper. The pin (Part D), when analyzed, could be one of three plain carbon steels, most probably 1015. The filler material (Part E) used to braze or possibly solder the pin (Part D) and contact (Part C) is silver based with significant additions of copper, cadmium, and zinc. It is unlikely that these components were "silver" soldered due to the lack of tin or lead found in the chemistry of the material. The filler material used resembles BAg-1a or BAg-3 with approximately two percent to five percent less Cd and Zn or Ni than required.

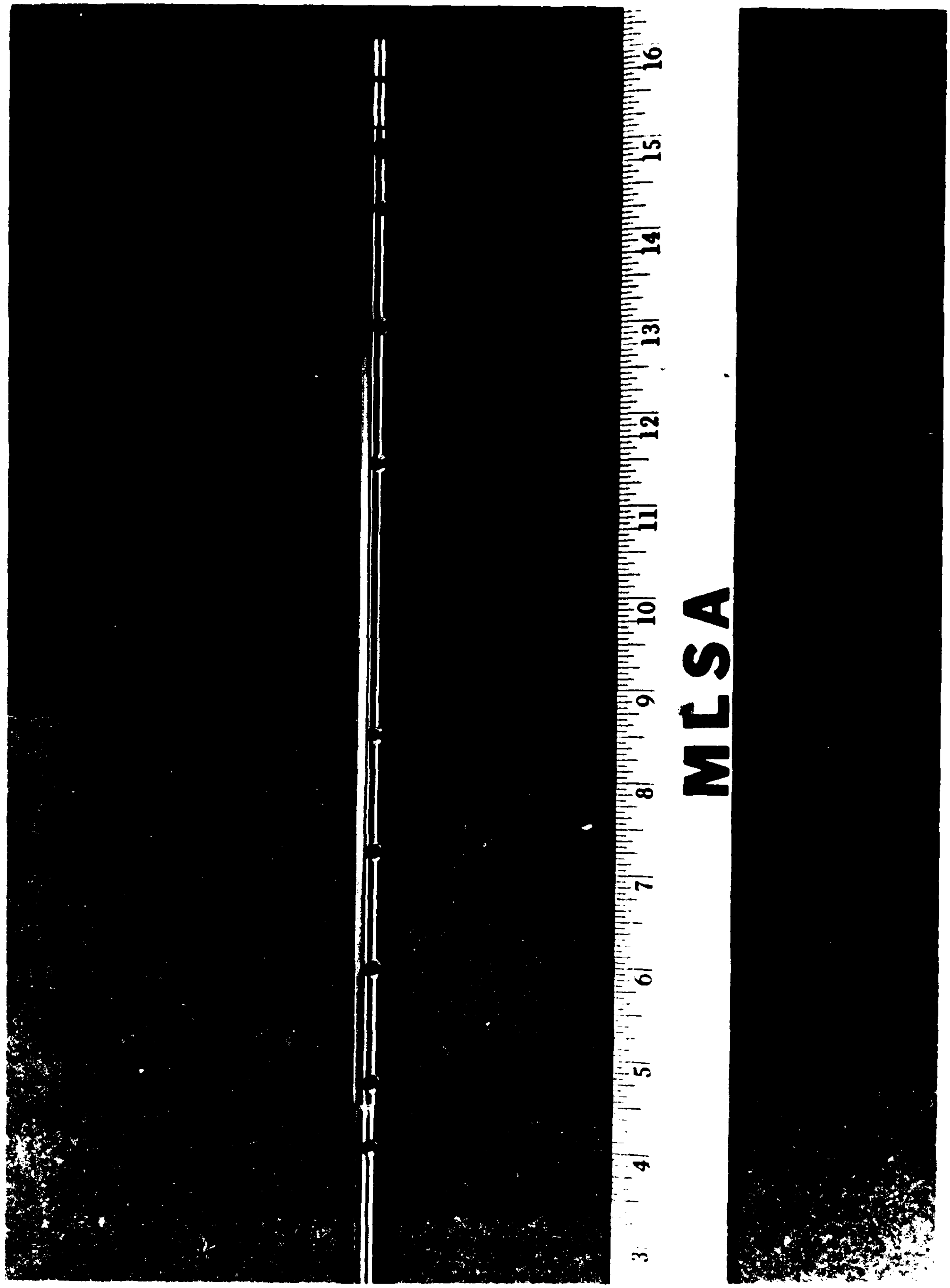


Figure 1. Shaft, Shouldered

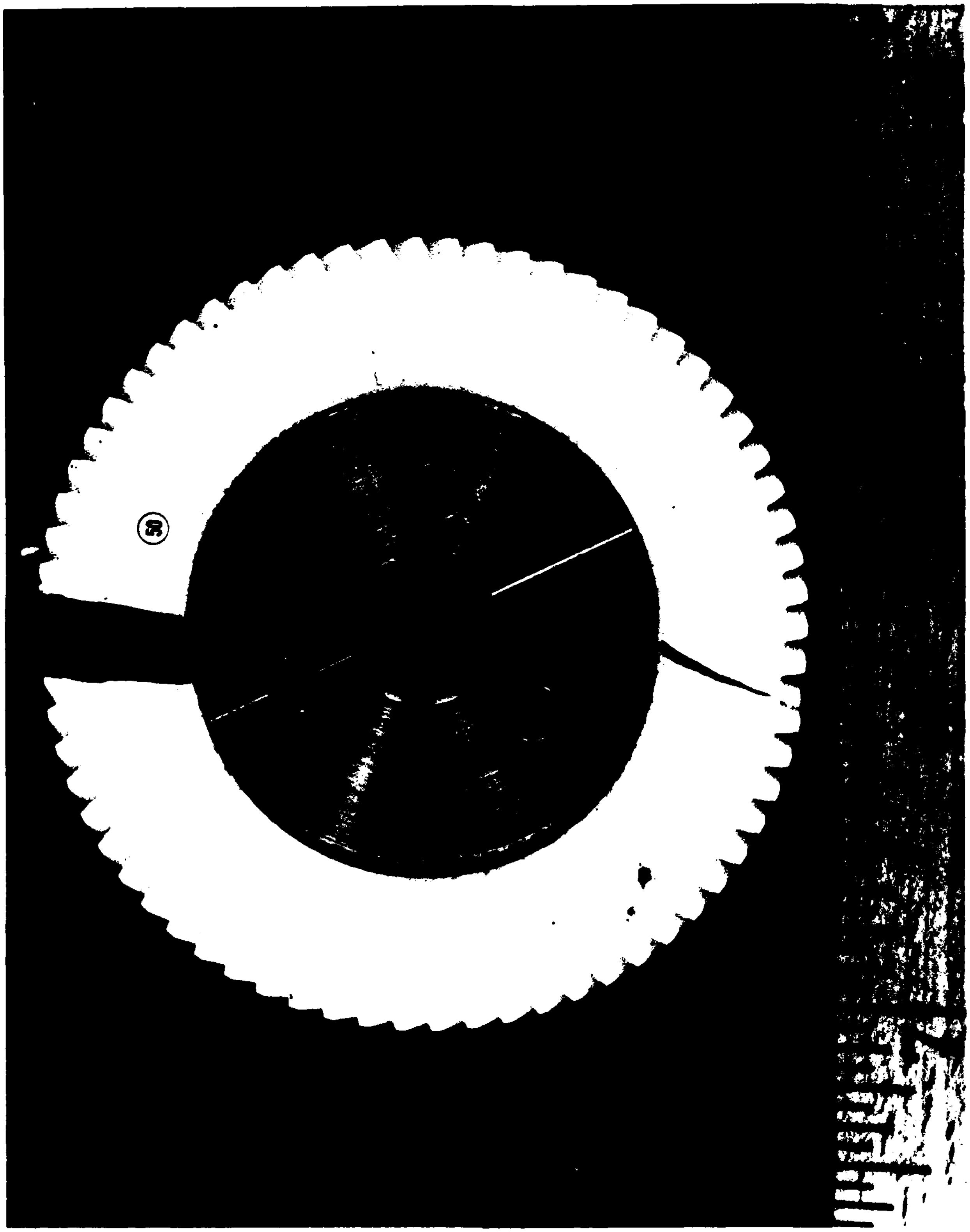


Figure 2a. Gear (Front)

Figure 2b. Gear (Edge)

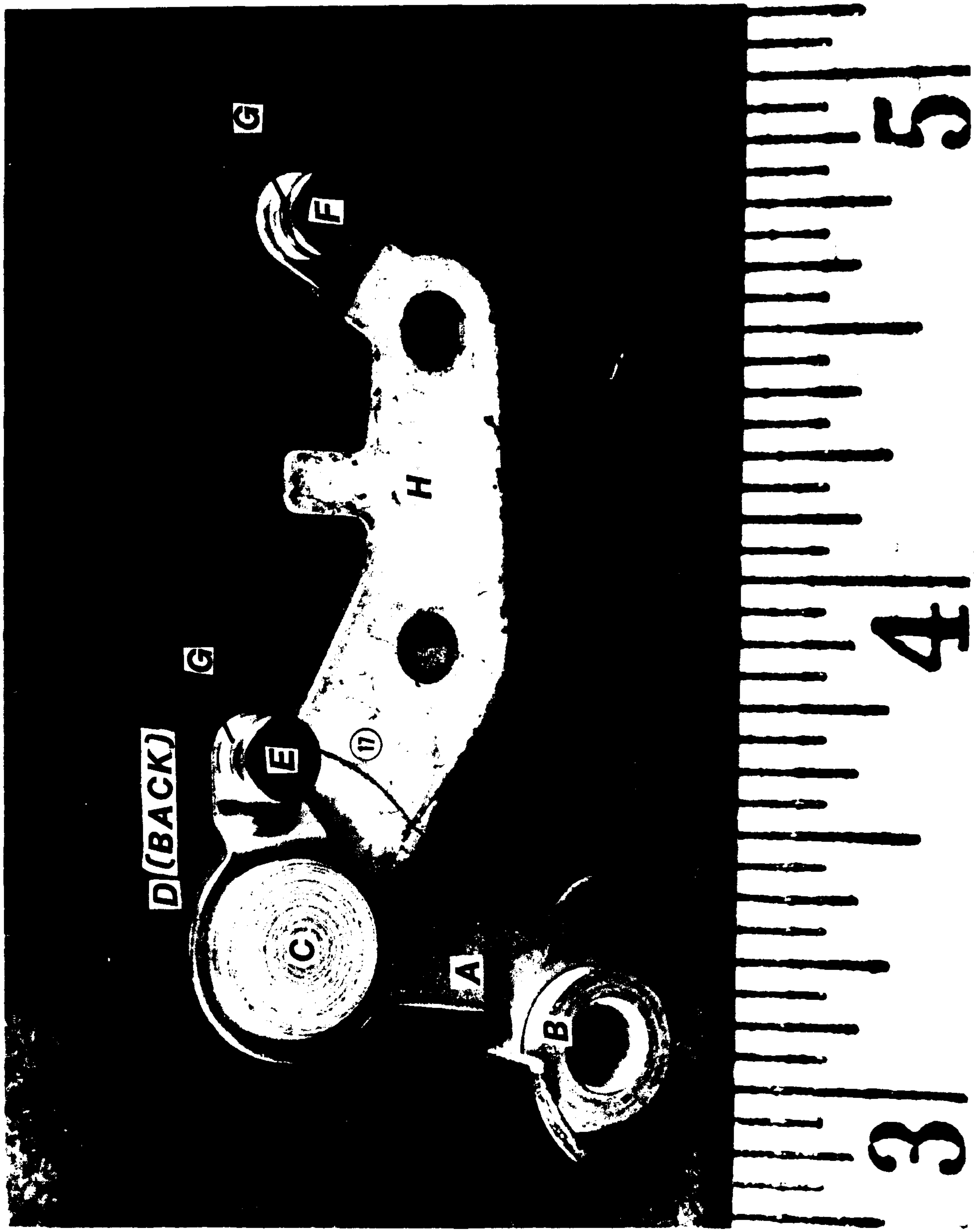


Figure 3. Link

Figure 4. Lever

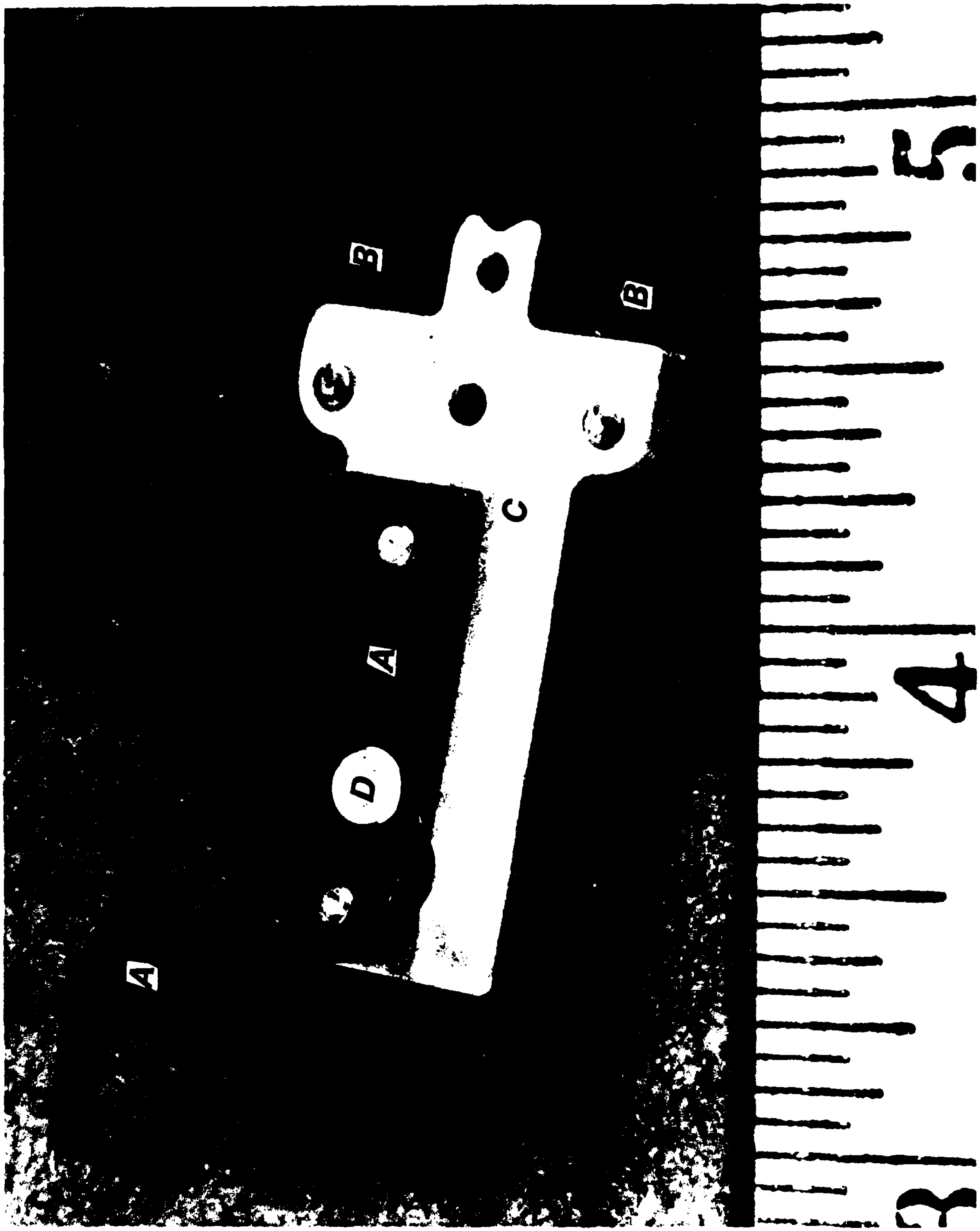


Figure 5a. Armature Assembly (Front)

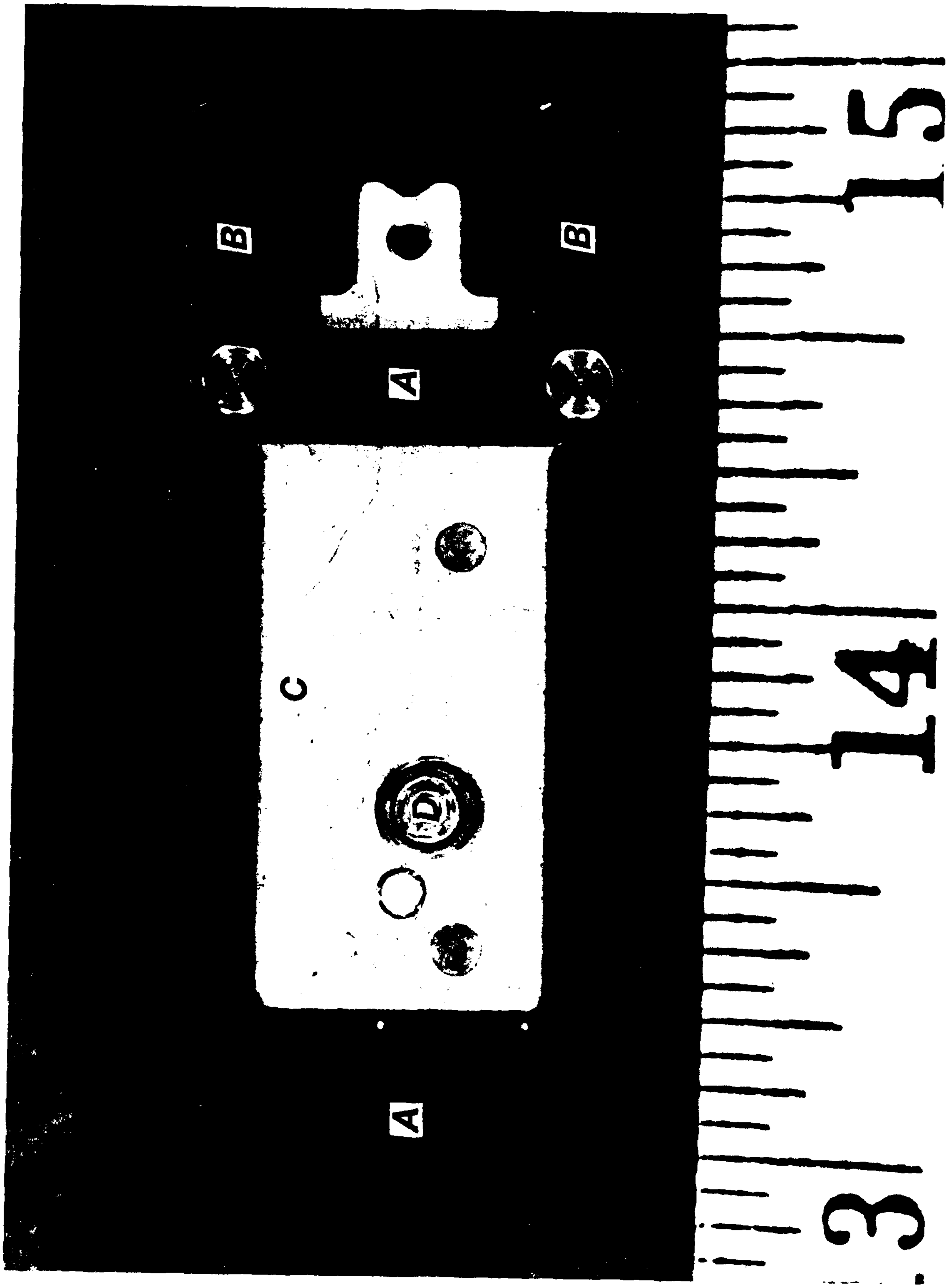


Figure 5b. Armature Assembly (Back)

Figure 6a. Latch, Lever (Front)

Figure 6b. Latch, Lever (Back)

Figure 7. Bail

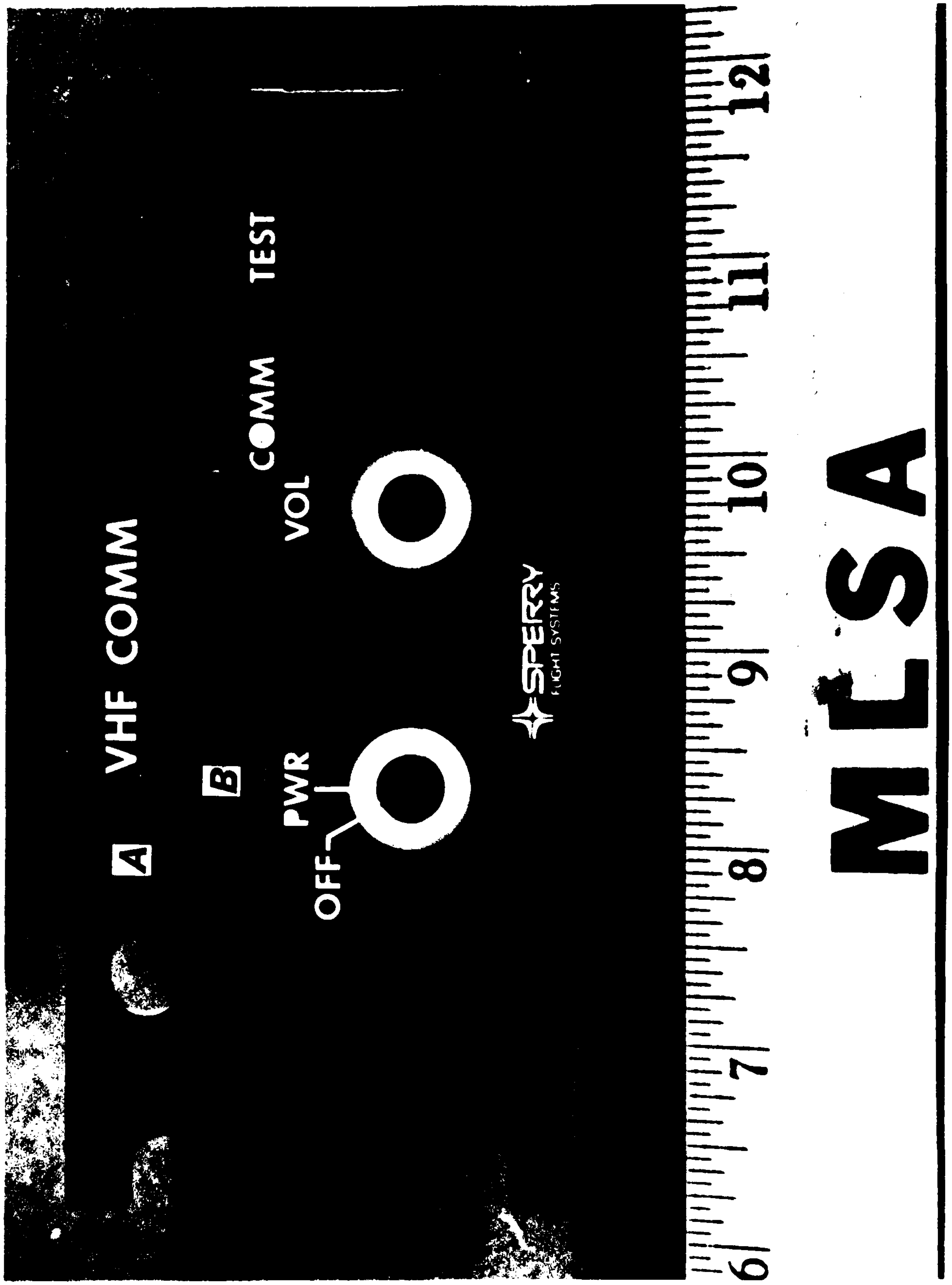


Figure 8a. Panel-Radio (Front)

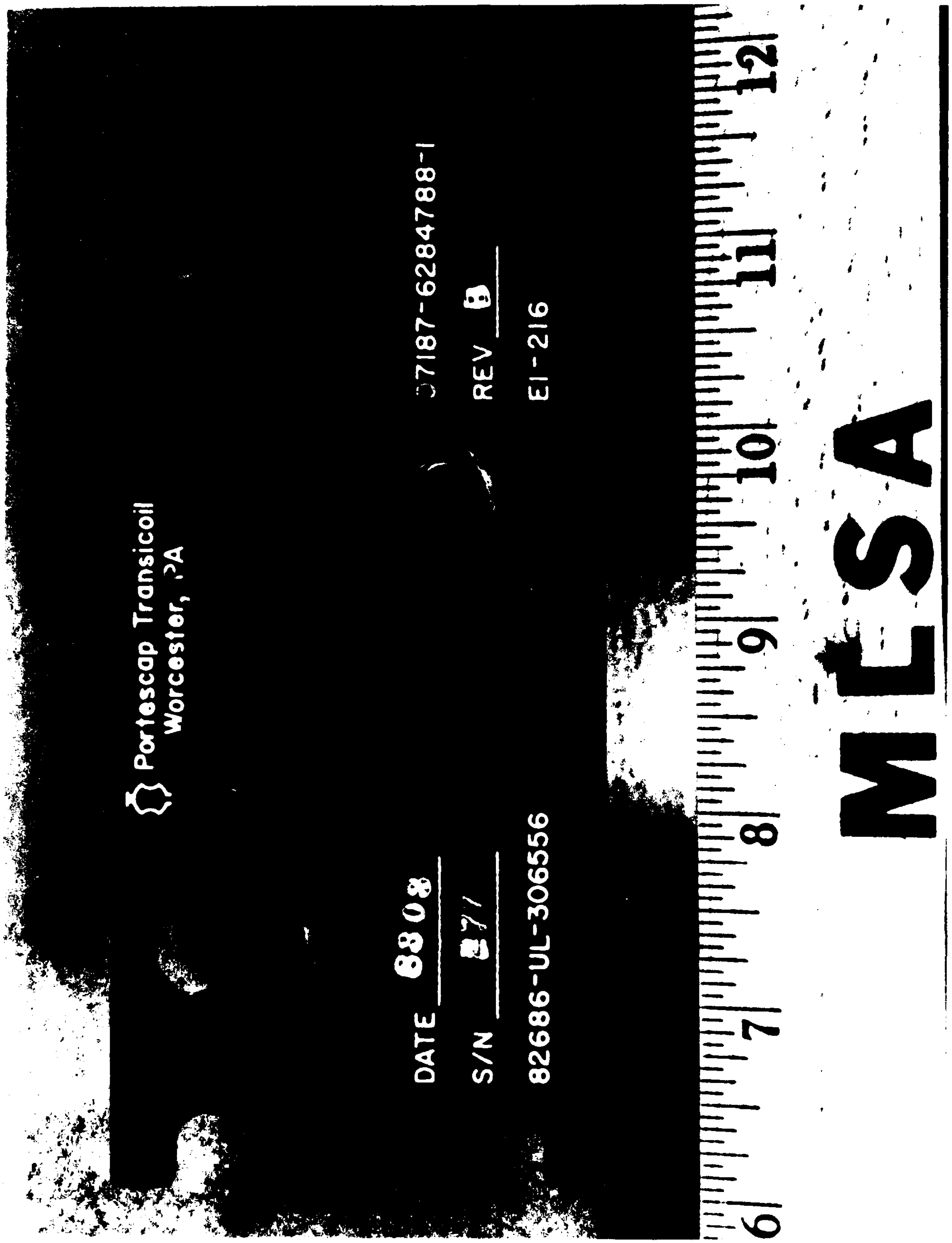


Figure 8b. Panel-Radio (Back)

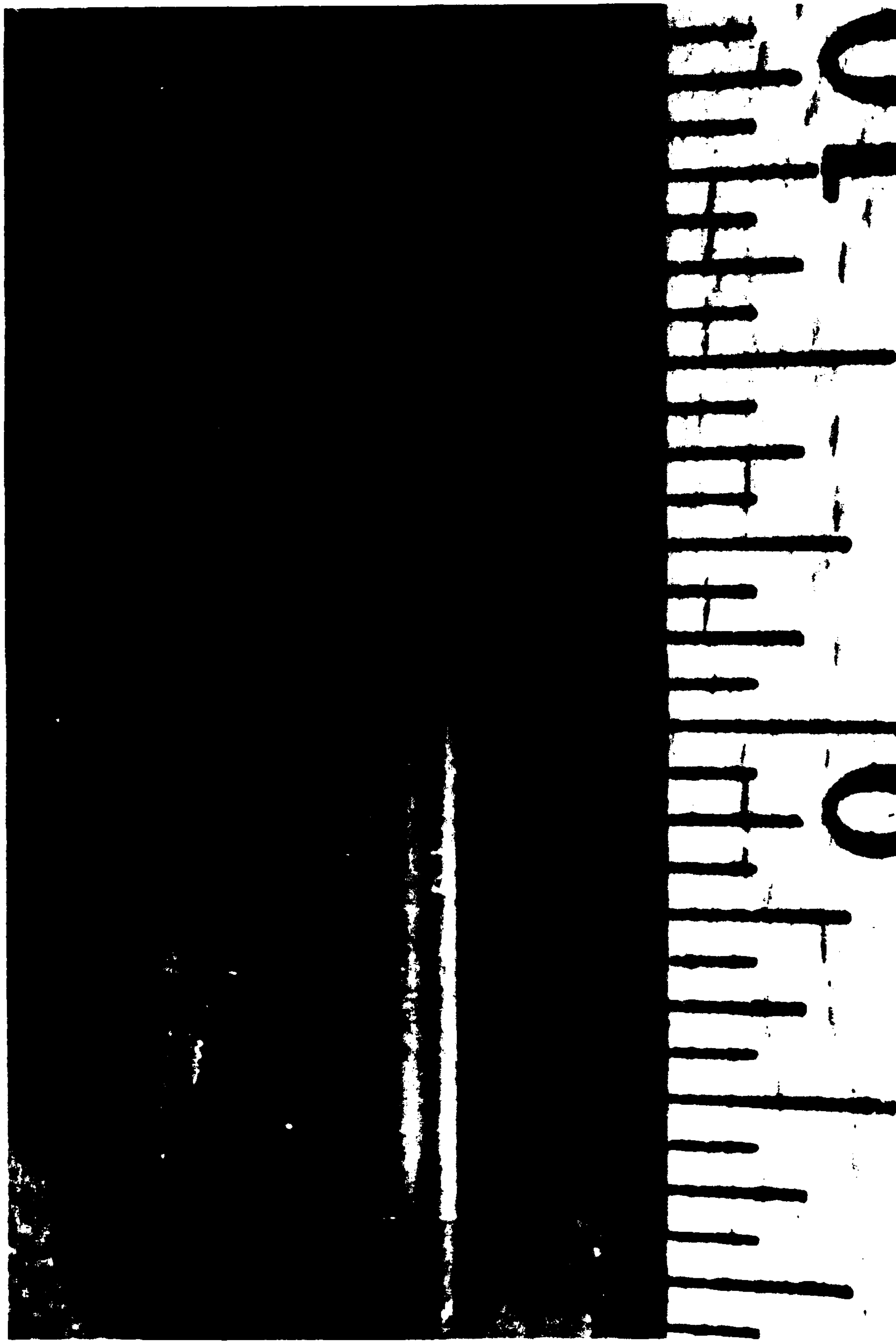


Figure 8c. Panel-Radio (Lens, Front)

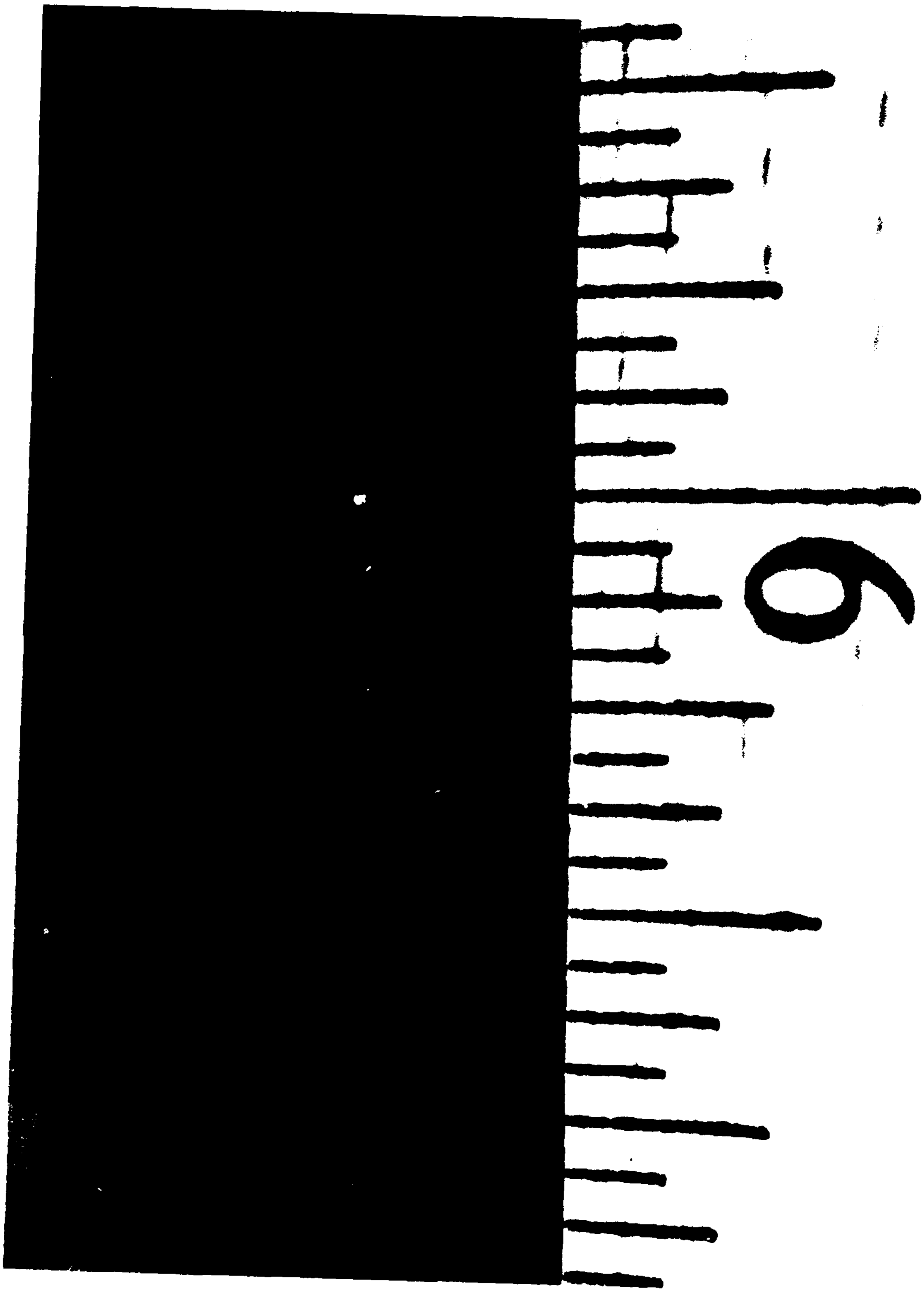


Figure 8d. Panel-Radio (Lens, Edge)

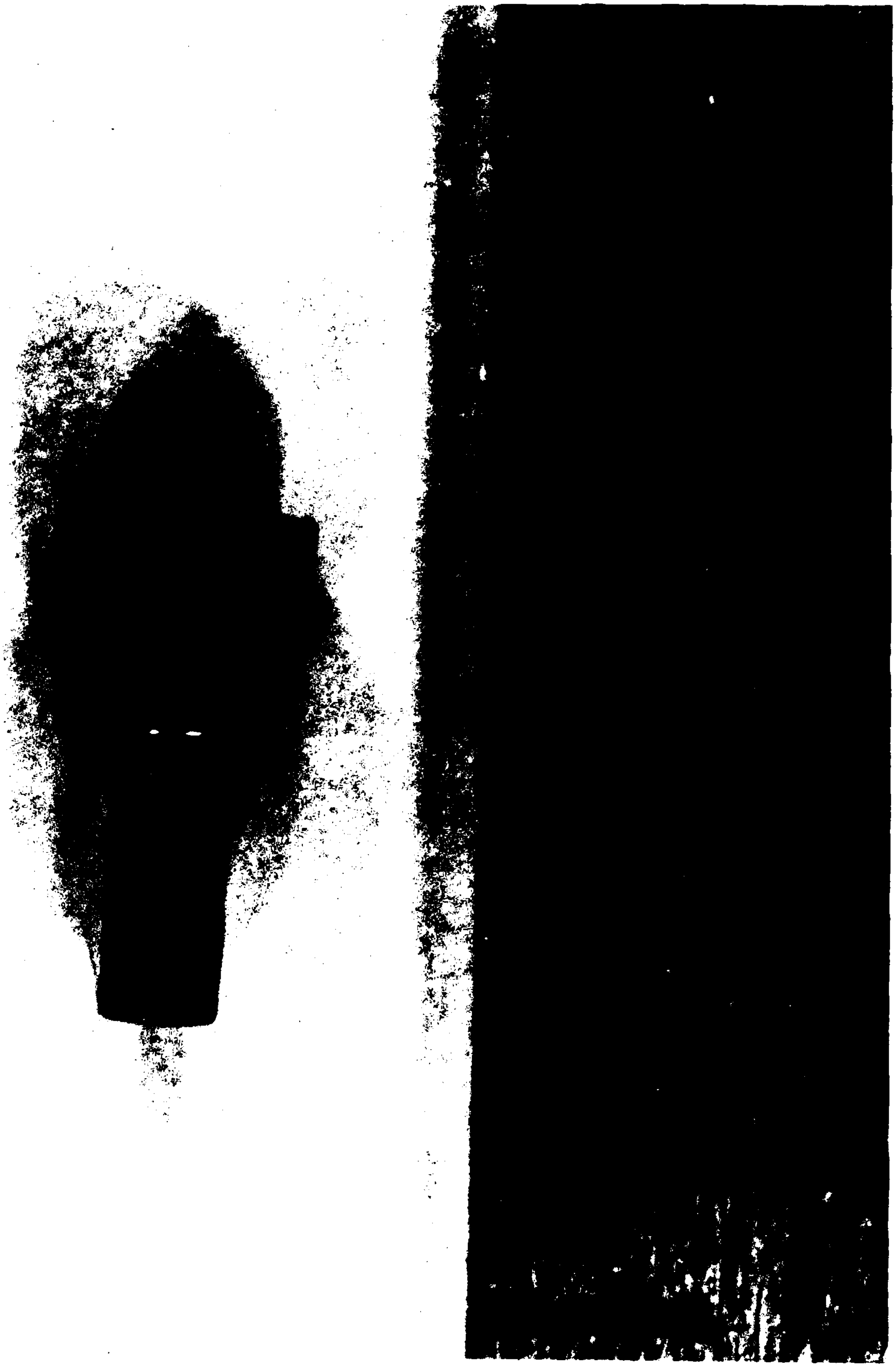


Figure 9. Head

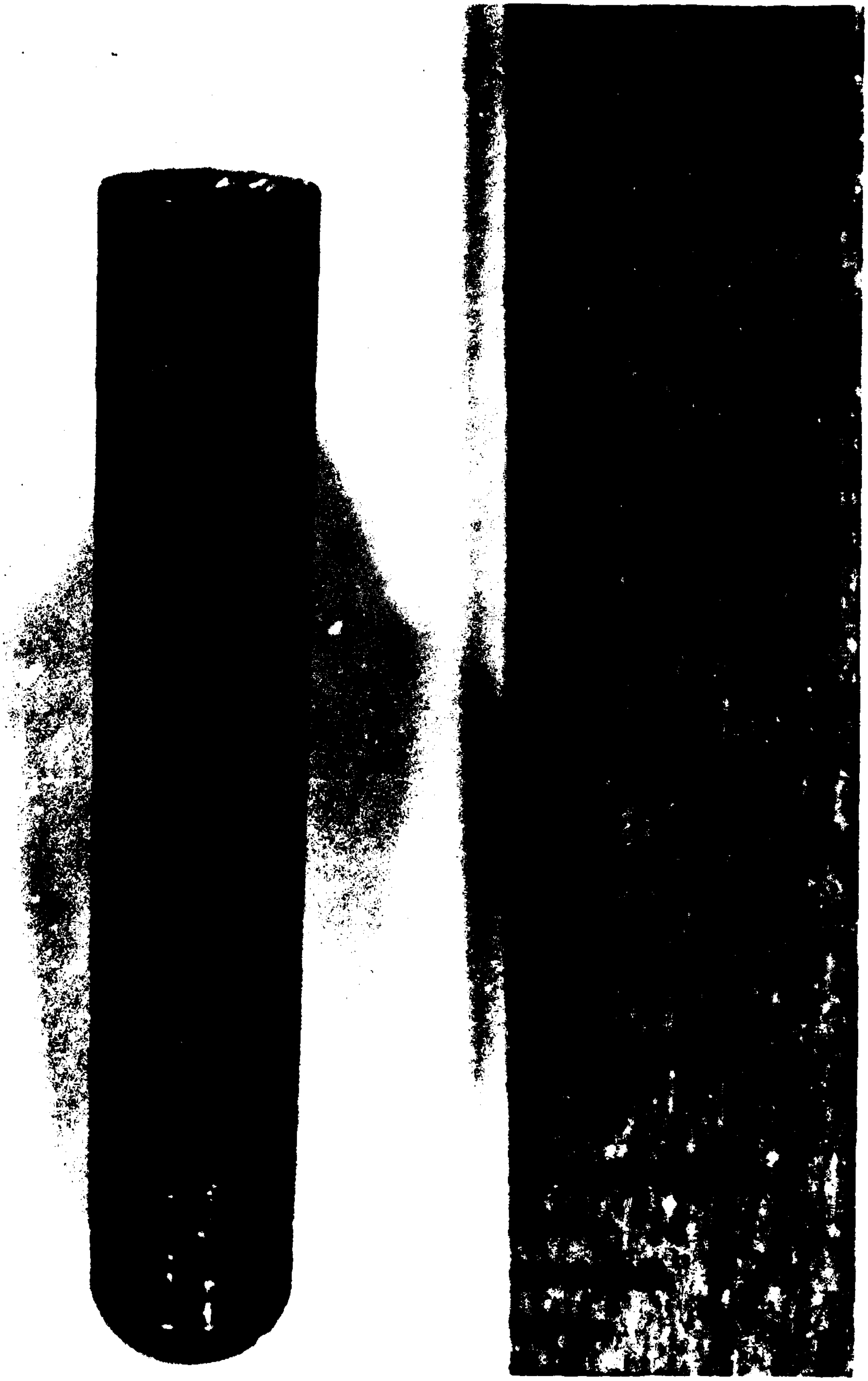


Figure 10. Contact

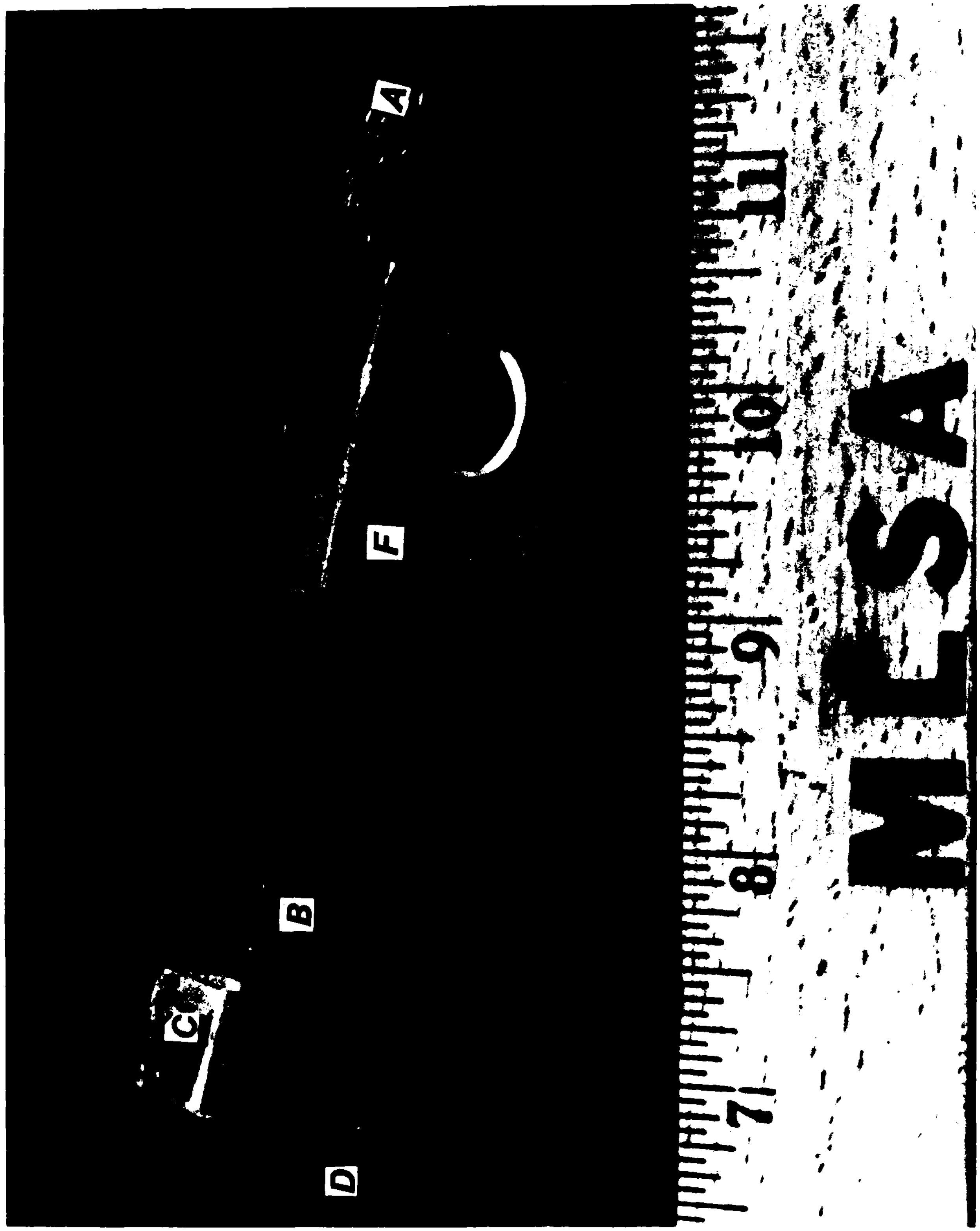


Figure 11a. Contact (Front, Top)

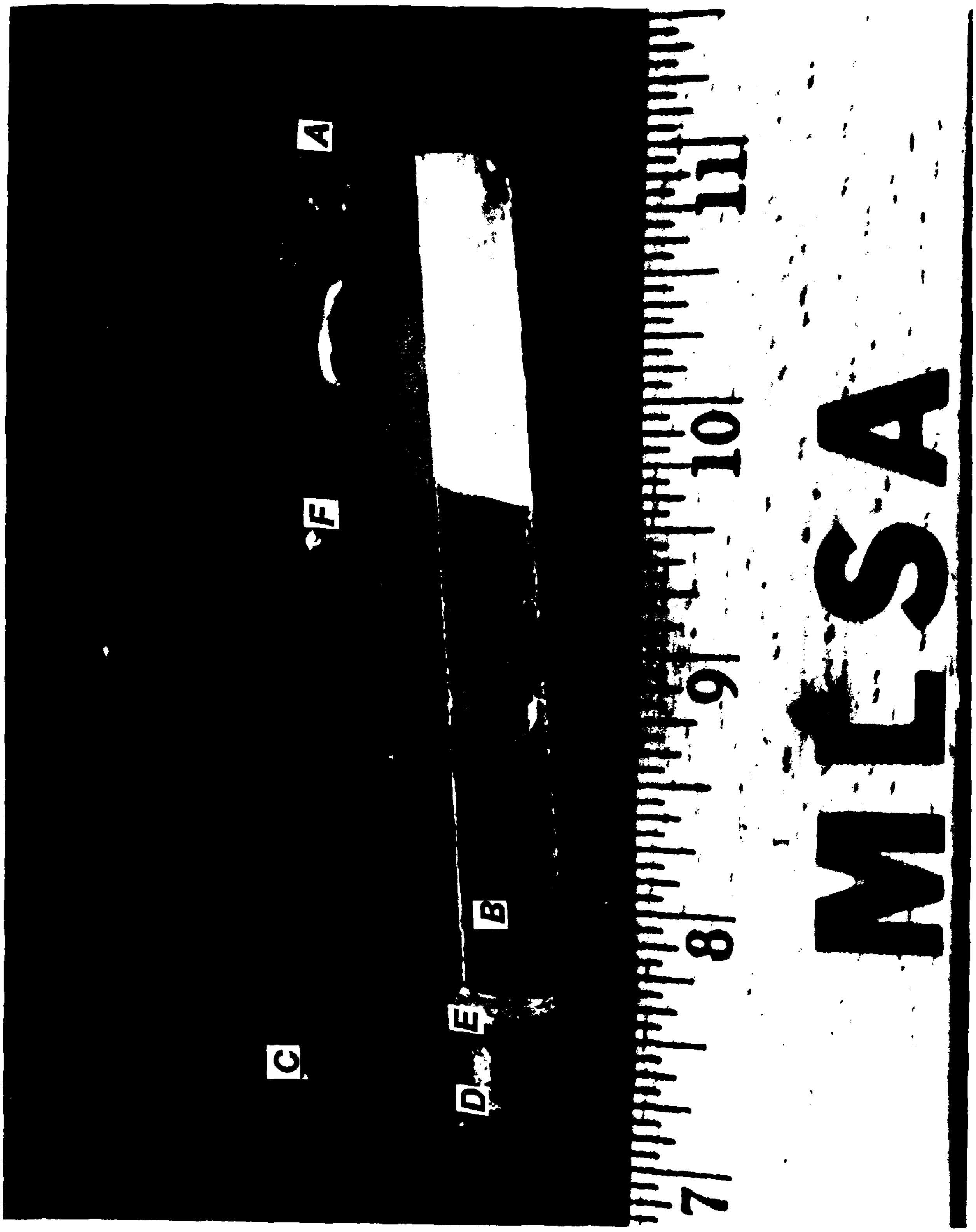


Figure 11b. Contact (Back, Bottom)

TABLE 4

ALLOY STEEL HEAT COMPOSITION RANGES AND LIMITS — BARS, BLOOMS, BILLETS AND SLABS

Element	Limit or max of specified range, %	Range, % Open hearth or basic oxygen steel	Range, % Electric furnace steel
Carbon	To 0.55 incl	0.05	0.05
	Over 0.55 to 0.70 incl	0.08	0.07
	Over 0.70 to 0.80 incl	0.10	0.09
	Over 0.80 to 0.95 incl	0.12	0.11
	Over 0.95 to 1.35 incl	0.13	0.12
Manganese	To 0.60 incl	0.20	0.15
	Over 0.60 to 0.90 incl	0.20	0.20
	Over 0.90 to 1.05 incl	0.25	0.25
	Over 1.05 to 1.90 incl	0.30	0.30
	Over 1.90 to 2.10 incl	0.40	0.35
Sulfur(a)	To 0.050 incl	0.015	0.015
	Over 0.050 to 0.07 incl	0.02	0.02
	Over 0.07 to 0.10 incl	0.04	0.04
	Over 0.10 to 0.14 incl	0.05	0.05
Silicon	To 0.15 incl	0.08	0.08
	Over 0.15 to 0.20 incl	0.10	0.10
	Over 0.20 to 0.40 incl	0.15	0.15
	Over 0.40 to 0.60 incl	0.20	0.20
	Over 0.60 to 1.00 incl	0.30	0.30
	Over 1.00 to 2.20 incl	0.40	0.35
Chromium	To 0.40 incl	0.15	0.15
	Over 0.40 to 0.90 incl	0.20	0.20
	Over 0.90 to 1.05 incl	0.25	0.25
	Over 1.05 to 1.60 incl	0.30	0.30
	Over 1.60 to 1.75 incl	(b)	0.35
	Over 1.75 to 2.10 incl	(b)	0.40
	Over 2.10 to 3.99 incl	(b)	0.50
Nickel	To 0.50 incl	0.20	0.20
	Over 0.50 to 1.50 incl	0.30	0.30
	Over 1.50 to 2.00 incl	0.35	0.35
	Over 2.00 to 3.00 incl	0.40	0.40
	Over 3.00 to 5.30 incl	0.50	0.50
	Over 5.30 to 10.00 incl	1.00	1.00

Element	Limit or max of specified range, %	Range, % Open hearth or basic oxygen steel	Range, % Electric furnace steel
Molybdenum	To 0.10 incl	0.05	0.05
	Over 0.10 to 0.20 incl	0.07	0.07
	Over 0.20 to 0.50 incl	0.10	0.10
	Over 0.50 to 0.80 incl	0.15	0.15
	Over 0.80 to 1.15 incl	0.20	0.20
Tungsten	To 0.50 incl	0.20	0.20
	Over 0.50 to 1.00 incl	0.30	0.30
	Over 1.00 to 2.00 incl	0.50	0.50
	Over 2.00 to 4.00 incl	0.60	0.60
Copper	To 0.60 incl	0.20	0.20
	Over 0.60 to 1.50 incl	0.30	0.30
	Over 1.50 to 2.00 incl	0.35	0.35
Vanadium	To 0.25 incl	0.05	0.05
	Over 0.25 to 0.50 incl	0.10	0.10
Aluminum	Up to 0.10 incl	0.05	0.05
	Over 0.10 to 0.20 incl	0.10	0.10
	Over 0.20 to 0.30 incl	0.15	0.15
	Over 0.30 to 0.80 incl	0.25	0.25
	Over 0.80 to 1.30 incl	0.35	0.35
	Over 1.30 to 1.80 incl	0.45	0.45

Element	Steelmaking Process	Lowest max, % (c)
Phosphorus	Basic open hearth, basic oxygen or basic electric furnace steels	0.035 (d)
	Basic electric furnace "E" steels	0.025
	Acid open hearth or electric furnace steel	0.050
Sulfur	Basic open hearth, basic oxygen or basic electric furnace steels	0.040 (d)
	Basic electric furnace "E" steels	0.025
	Acid open hearth or electric furnace steel	0.050

(a) A range of sulfur content normally indicates a resulfurized steel. (b) Not normally produced by open hearth process. (c) Not applicable to rephosphorized or resulfurized steels. (d) Lower maximum limits on phosphorus and sulfur are required by certain quality descriptors.

TABLE 5. ALLOY STEEL HEAT COMPOSITION RANGES AND LIMITS — PLATE

Element	Limit or max of specified range, %	Range, % Open hearth or basic oxygen steels	Range, % Electric furnace steels
Carbon	To 0.25 incl	0.06	0.05
	Over 0.25 to 0.40 incl	0.07	0.06
	Over 0.40 to 0.55 incl	0.08	0.07
	Over 0.55 to 0.70 incl	0.11	0.10
	Over 0.70	0.14	0.13
Manganese	To 0.45 incl	0.20	0.15
	Over 0.45 to 0.80 incl	0.25	0.20
	Over 0.80 to 1.15 incl	0.30	0.25
	Over 1.15 to 1.70 incl	0.35	0.30
	Over 1.70 to 2.10 incl	0.40	0.35
Sulfur(a)	To 0.060 incl	0.02	0.02
	Over 0.060 to 0.100 incl	0.04	0.04
	Over 0.100 to 0.140 incl	0.05	0.05
Silicon	To 0.15 incl	0.08	0.08
	Over 0.15 to 0.20 incl	0.10	0.10
	Over 0.20 to 0.40 incl	0.15	0.15
	Over 0.40 to 0.60 incl	0.20	0.20
	Over 0.60 to 1.00 incl	0.30	0.30
	Over 1.00 to 2.20 incl	0.40	0.35
Chromium	To 0.40 incl	0.20	0.15
	Over 0.40 to 0.80 incl	0.25	0.20
	Over 0.80 to 1.05 incl	0.30	0.25
	Over 1.05 to 1.25 incl	0.35	0.30
	Over 1.25 to 1.75 incl	0.50	0.40
	Over 1.75 to 3.99 incl	0.60	0.50
Nickel	To 0.50 incl	0.20	0.20
	Over 0.50 to 1.50 incl	0.30	0.30
	Over 1.50 to 2.00 incl	0.35	0.35
	Over 2.00 to 3.00 incl	0.40	0.40

Element	Limit or max of specified range, %	Range, % Open hearth or basic oxygen steels	Range, % Electric furnace steels
Nickel	Over 3.00 to 5.30 incl	0.50	0.50
	Over 5.30 to 10.00 incl	1.00	1.00
Molybdenum	To 0.10 incl	0.05	0.05
	Over 0.10 to 0.20 incl	0.07	0.07
	Over 0.20 to 0.50 incl	0.10	0.10
	Over 0.50 to 0.80 incl	0.15	0.15
	Over 0.80 to 1.15 incl	0.20	0.20
Tungsten	To 0.50 incl	0.20	0.20
	Over 0.50 to 1.00 incl	0.30	0.30
	Over 1.00 to 2.00 incl	0.50	0.50
	Over 2.00 to 4.00 incl	0.60	0.60
Copper	To 0.60 incl	0.20	0.20
	Over 0.60 to 1.50 incl	0.30	0.30
	Over 1.50 to 2.00 incl	0.35	0.35
Vanadium	To 0.25 incl	0.05	0.05
	Over 0.25 to 0.50 incl	0.10	0.10
Aluminum	Up to 0.10 incl	0.05	0.05
	Over 0.10 to 0.20 incl	0.10	0.10
	Over 0.20 to 0.30 incl	0.15	0.15
	Over 0.30 to 0.80 incl	0.25	0.25
	Over 0.80 to 1.30 incl	0.35	0.35
	Over 1.30 to 1.80 incl	0.45	0.45
Steelmaking Process		**Lowest max, %(b)**	
Phosphorus	Basic open hearth or basic oxygen	0.035(c)	
	Basic electric furnace	0.025	
Sulfur	Basic open hearth or basic oxygen	0.040(c)	
	Basic electric furnace	0.025	

(a) A range of sulfur content normally indicates a resulfurized steel. (b) Not applicable to resulfurized or rephosphorized steels. (c) Lower maximum limits on phosphorus and sulfur are required by certain quality descriptors.

TABLE 6A. CARBON STEEL PRODUCT COMPOSITION TOLERANCES

Element	Limit or max of specified range, %	Tolerance over max or under min limits, % — Cross-sectional area of product: to 100 in.²	100-200 in.²	200-400 in.²	400-800 in.²
Carbon	To 0.25 incl	0.02	0.03	0.04	0.05
	Over 0.25 to 0.55 incl	0.03	0.04	0.05	0.06
	Over 0.55	0.04	0.05	0.06	0.07
Manganese	To 0.90 incl	0.03	0.04	0.06	0.07
	Over 0.90 to 1.65 incl	0.06	0.06	0.07	0.08
Phosphorus	Over maximum only, to 0.040 incl	0.008	0.008	0.010	0.015
Sulfur	Over maximum only, to 0.050 incl	0.008	0.010	0.010	0.015
Silicon	To 0.35 incl	0.02	0.02	0.03	0.04
	Over 0.35 to 0.60 incl	0.05	...	...	...
Copper	Under minimum only	0.02	0.03	...	...
Lead	0.15 to 0.35 incl	0.03	0.03	...	...

Note: Product composition requirements are not applicable to: (a) rimmed or capped steels; (b) boron content of boron steels; (c) phosphorus and sulfur contents of rephosphorized and resulfurized steels. Product composition tolerances for alloying elements in HSLA steels are given in Table 7.

TABLE 6B

CARBON STEEL HEAT COMPOSITION RANGES AND LIMITS - STRUCTURAL SHAPES, PLATE, STRIP, SHEET AND WELDED TUBING

Element	Limit or max of specified range, %	Range, %	Element	Limit or max of specified range, %	Range, %
Carbon			Sulfur		
(a)	0.08 (b)(c) to 0.15 incl	0.05	(d)	0.05 to 0.08 incl	0.03
	Over 0.15 to 0.30 incl	0.06		Over 0.08 to 0.15 incl	0.05
	Over 0.30 to 0.40 incl	0.07		Over 0.15 to 0.23 incl	0.07
	Over 0.40 to 0.60 incl	0.08		Over 0.23 to 0.33 incl	0.10
	Over 0.60 to 0.80 incl	0.11	Silicon ...	0.10 to 0.15 incl	0.08
	Over 0.80 to 1.35 incl	0.14		Over 0.15 to 0.30 incl	0.15
Manganese	0.40 (b) to 0.50 incl	0.20		Over 0.30 to 0.60 incl	0.30
	Over 0.50 to 1.15 incl	0.30			
	Over 1.15 to 1.65 incl	0.35			
Phosphorus					
(d)	0.04 (b) to 0.08 incl	0.03			
	Over 0.08 to 0.15 incl	0.05			

(a) Add 0.01 to specified carbon range for steels with manganese contents exceeding 1.00%. (b) Lowest permissible maximum limit for this element. (c) 0.12% for structural shapes and plate. (d) Lower maximum limits on phosphorus and sulfur are required by certain quality descriptors.

TABLE 6C

CARBON STEEL HEAT COMPOSITION RANGES AND LIMITS — SEMIFINISHED PRODUCTS FOR FORGING, HOT ROLLED AND COLD FINISHED BARS, WIRE ROD AND SEAMLESS TUBING

Element	Limit or max of specified range, %	Range, %	Element	Limit or max of specified range, %	Range, %
Carbon			Sulfur		
(a)	To 0.25 incl	0.05	(b)	0.050 (c) to 0.09 incl	0.03
	Over 0.25 to 0.40 incl	0.06		Over 0.09 to 0.15	0.05
	Over 0.40 to 0.55 incl	0.07		Over 0.15 to 0.23 incl	0.07
	Over 0.55 to 0.80 incl	0.10		Over 0.23 to 0.35 incl	0.09
	Over 0.80	0.13	Silicon		
Manganese	To 0.40 incl	0.15	(d)	To 0.15 incl	0.08
	Over 0.40 to 0.50 incl	0.20		Over 0.15 to 0.20 incl	0.10
	Over 0.50 to 1.65 incl	0.30		Over 0.20 to 0.30 incl	0.15
				Over 0.30 to 0.60 incl	0.20
Phosphorus					
(b)	0.040 (c) to 0.08 incl	0.03			
	Over 0.08 to 0.13 incl	0.05			

(a) Add 0.01 to specified carbon ranges for steels with manganese contents exceeding 1.10%. (b) Lower maximum limits on phosphorus and sulfur are required by certain quality descriptors. (c) Lowest permissible maximum for this element. (d) Silicon content not normally specified for acid bessemer steels.

TABLE 7. ALLOY STEEL PRODUCT COMPOSITION TOLERANCES — BARS, BILLETS, BLOOMS AND SLABS

Element	Limit or max of specified range, %	Tolerance over max or under min limits, %(a) Cross-sectional area of product: to 100 in.²	100-200 in.²	200-400 in.²	400-800 in.²
Carbon	To 0.30 incl	0.01	0.02	0.03	0.04
	Over 0.30 to 0.75 incl	0.02	0.03	0.04	0.05
	Over 0.75	0.03	0.04	0.05	0.06
Manganese	To 0.90 incl	0.03	0.04	0.05	0.06
	Ove 0.90 to 2.10 incl	0.04	0.05	0.06	0.07
Phosphorus	Over max only	0.005	0.010	0.010	0.010
Sulfur	Over max only	0.005	0.010	0.010	0.010
Silicon	To 0.40 incl	0.02	0.02	0.03	0.04
	Over 0.40 to 2.20 incl	0.05	0.06	0.06	0.07
Chromium	To 0.90 incl	0.03	0.04	0.04	0.05
	Over 0.90 to 2.10 incl	0.05	0.06	0.06	0.07
	Over 2.10 to 3.99 incl	0.10	0.10	0.12	0.14
Nickel	To 1.00 incl	0.03	0.03	0.03	0.03
	Over 1.00 to 2.00 incl	0.05	0.05	0.05	0.05
	Over 2.00 to 5.30 incl	0.07	0.07	0.07	0.07
	Over 5.30 to 10.00 incl	0.10	0.10	0.10	0.10
Molybdenum	To 0.20 incl	0.01	0.01	0.02	0.03
	Over 0.20 to 0.40 incl	0.02	0.03	0.03	0.04
	Over 0.40 to 1.15 incl	0.03	0.04	0.05	0.06
Tungsten	To 1.00 incl	0.04	0.05	0.05	0.06
	Over 1.00 to 4.00 incl	0.08	0.09	0.10	0.12
Copper(b)	To 1.00 incl	0.03	...	...	...
	Over 1.00 to 2.00 incl	0.05	...	...	...
Vanadium	To 0.10 incl	0.01	0.01	0.01	0.01
	Over 0.10 to 0.25 incl	0.02	0.02	0.02	0.02
	Over 0.25 to 0.50 incl	0.03	0.03	0.03	0.03
	Min value specified, check under min limit(b)	0.01	0.01	0.01	0.01
Niobium(b)	To 0.10 incl	0.01(c)	...	...	...
Titanium(b)	To 0.10 incl	0.01(c)	...	...	...
Zirconium(b)	To 0.15 incl	0.03	...	...	...
Aluminum(b)	Up to 0.10 incl	0.03	...	...	...
	Over 0.10 to 0.20 incl	0.04	...	...	...
	Over 0.20 to 0.30 incl	0.05	...	...	...
	Over 0.30 to 0.80 incl	0.07	...	...	...
	Over 0.80 to 1.80 incl	0.10	...	...	...
Lead(b)	0.15 to 0.35 incl	0.03	...	...	...
Nitrogen(b)	To 0.030 incl	0.005	...	...	...

(a) Product composition requirements are not applicable to boron content of boron steels or sulfur content of resulfurized steels (b) Tolerances shown apply only to cross-sectional areas of 100 in.² or less. (c) If the minimum of the range is 0.01%, the lower tolerance is 0.005%

TABLE 8. ALLOY STEEL PRODUCT COMPOSITION TOLERANCES – PLATE

Element	Limit or max of specified range, %	Tolerance over max or under min limits, %
Carbon	To 0.30 incl	0.02
	Over 0.30 to 0.75 incl	0.03
	Over 0.75	0.04
Manganese	To 0.90 incl	0.04
	Over 0.90 to 2.10 incl	0.05
Phosphorus (a)	Over max only	0.01
Sulfur (a) (b)	...	0.01
Silicon	To 0.40 incl	0.02
	Over 0.40 to 2.20 incl	0.06
Chromium	To 0.90 incl	0.04
	Over 0.90 to 2.10 incl	0.06
	Over 2.10 to 3.99 incl	0.10
Nickel	To 1.00 incl	0.03
	Over 1.00 to 2.00 incl	0.05
	Over 2.00 to 5.30 incl	0.07
	Over 5.30	0.10
Molybdenum	To 0.20 incl	0.01
	Over 0.20 to 0.40 incl	0.03
	Over 0.40 to 1.15 incl	0.04
Tungsten	To 1.00 incl	0.05
	Over 1.00 to 4.00 incl	0.09
Copper	To 1.00 incl	0.03
	Over 1.00 to 2.00 incl	0.05
Vanadium	To 0.10 incl	0.01
	Over 0.10 to 0.25 incl	0.02
	Over 0.25 to 0.50 incl	0.03
	Min value specified check under min limit	0.01
Aluminum	Up to 0.10 incl	0.03
	Over 0.10 to 0.20 incl	0.04
	Over 0.20 to 0.30 incl	0.05
	Over 0.30 to 0.80 incl	0.07
	Over 0.80 to 1.80 incl	0.10

(a) For pressure-vessel quality plate, the specified composition includes product composition tolerances for phosphorus and sulfur (b) Product composition requirements not applicable to sulfur content of resulfurized steel.

APPENDIX

HISTORY OF PRIOR EFFORTS

Analysis of VHF COMM Cover Panel

SAMPLE DESCRIPTION

1.) A black panel was received for materials characterization. Included as a part of the panel assembly was a clear magnifying lens which was fitted into a rectangular hole in the cover plate.

2.) The front face (e.g. pilot's view) of the panel shows two types of lettering: that associated with control functions (VHF, COMM, COMM TEST, -PWR, -OFF) and that identifying the manufacturer ("Sperry Flight Systems" and a logo).

3.) All lettering on the front face of the panel appears as white on the black background of the panel.

4.) The rear face of the panel shows lettering associated with part identification (DATE______, S/N_____, 82686-UL-306556) as well as another company name (Portescap Transicoil, Worcester, PA) and logo.

5.) The lettering on the rear face of the panel appears as white on the black background of the panel.

6.) The panel appears, in cross section, to consist of a clear base material coated with a white material and then a black material. There is some evidence suggesting that a clear top coat is used on the front face of the panel. Examination of the various printed areas on the front and rear faces of the panel suggests that the lettering attributed above to control functions is applied differently than that associated with the part and/or manufacturer(s) identifications noted in paragraphs 2 and 4 above.

7.) During the initial evaluation of the sample the following were identified as items of interest:

- Identification of lens material
- Identification of base material
- Identification of black coating
- Identification of white coating
- Differentiation of white lettering types
- Identification of top coat

RESULTS AND DISCUSSION

Infrared Absorption analysis (IR) of the lens material shows it to be a polycarbonate. A search of the Sadtler Library of reference IR spectra did not yield a unique match of the IR spectrum of this material to that of a specific commercial polycarbonate formulation.

IR analysis of the base material used for the panel shows it to be a polymethylmethacrylate ("plexiglas"). A search of the Sadtler Library of reference IR spectra did not yield a unique match of the IR spectrum of this material to that of a specific commercial polymethylmetacrylate formulation.

IR analysis of the black coating suggests that it is a polyamide. Carbon, hydrogen, and nitrogen analysis of a portion of the coating supports this identification. Emission spectroscopic (ES) analysis shows the principal element detectable by ES to be silicon.

IR analysis of the white coating suggests that it is also a polyamide. Carbon, hydrogen, and nitrogen analysis data supports this identification and ES analysis shows the principal ES detectable element to be titanium.

Examination of the panel by optical microscopy suggests that method used to achieve the "function" lettering on the front face of the panel (VHF, COMM, COMM TEST, -PWR, -OFF) is different from that used to apply the manufacturer identification(s), part number, serial number, etc.

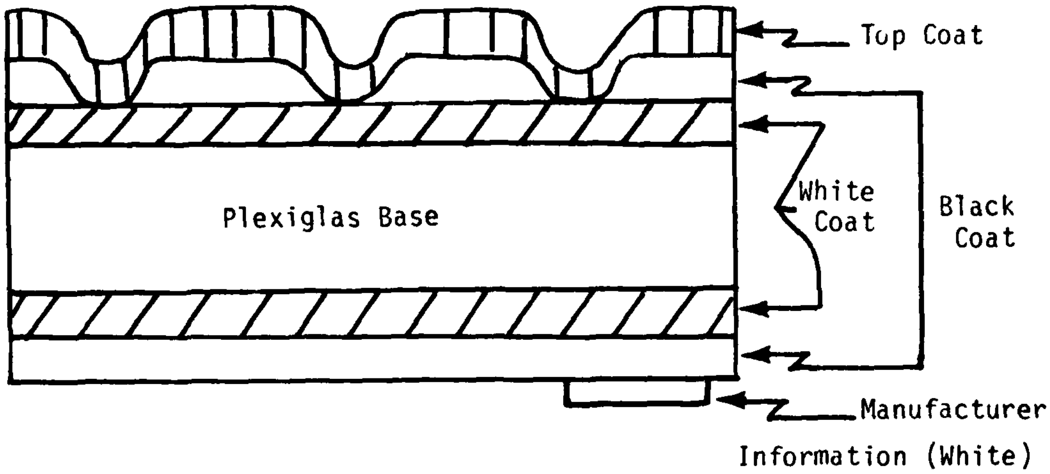
The function and equipment identification lettering appears to result from the black coating having been removed after application or masked during application to permit the white coating below it to form this lettering. The manufacturer information appears to have been applied atop the black coating. If the panel were edge lit, then, presumably, the function information would be illuminated while the manufacturer information would not.

In examining the function and identification lettering, it is apparent that the front face of the panel has a clear top coat over the black coating. This top coat is most apparent in the area of the function lettering. The rear face of the panel does not appear to have a top coat.

IR analysis suggests that the clear top coat is a polyamide.

Figure 1 shows a cross section of the panel illustrating the data discussed above.

Figure 1
(Not to Scale)



ANALYSIS REPORT

TO

TECHNICAL SERVICES GROUP
AFWAL/MLU-ACG
WPAFB, OHIO 45433
(513) 253-0282

DATE
18 Jul 84

MLU NUMBER
27469

JOB ORDER NUMBER
24180703

Infrared analysis of the "plastic panel" portion of sample MLSA #27469 indicates that this material is a methyl methacrylate (plexiglas) type polymer.

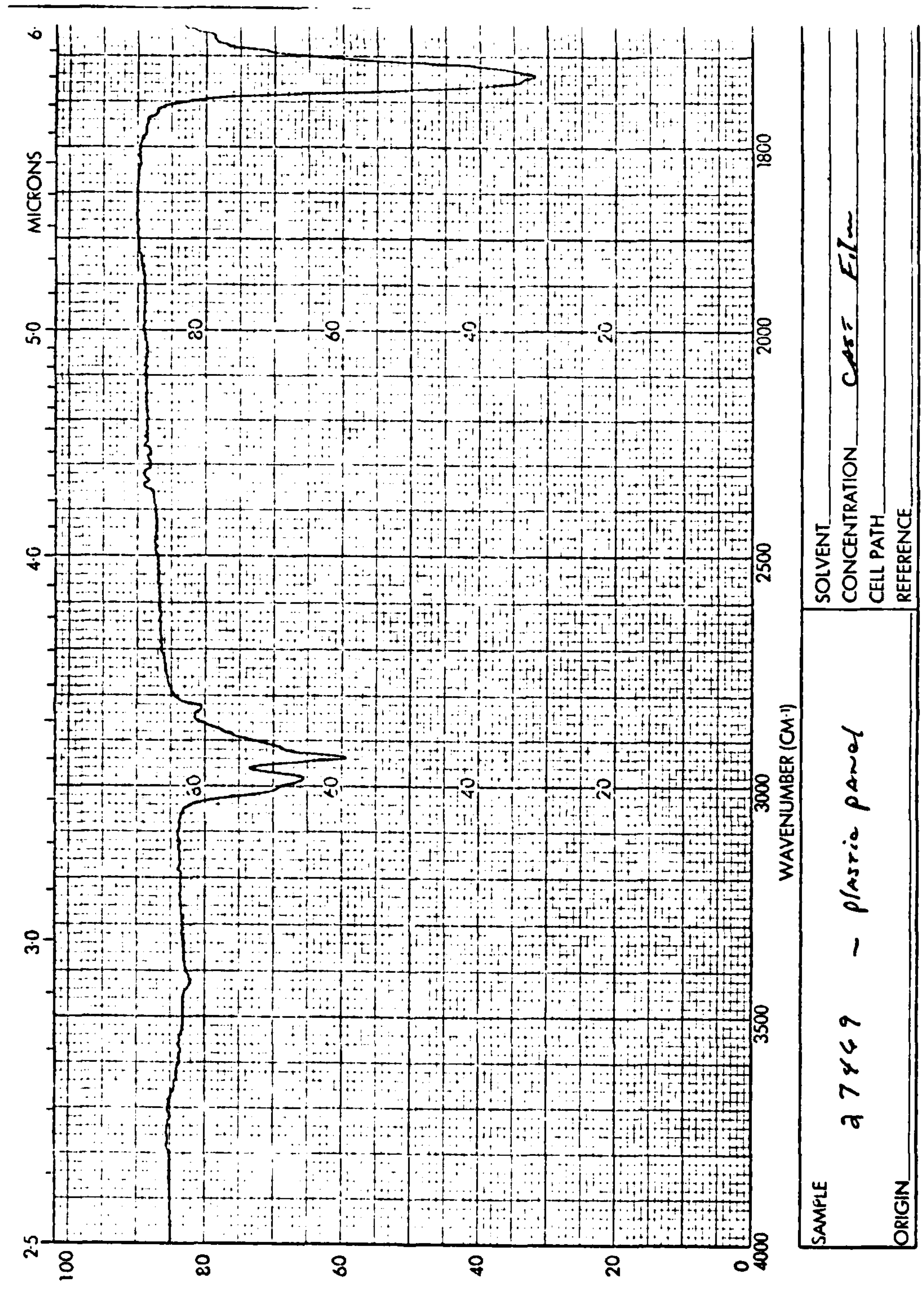
The "plastic curved screen" portion of the sample appears to be a polycarbon type polymer. The IR spectrum of this component compares favorably with "Lexan 141" (General Electric Co.)

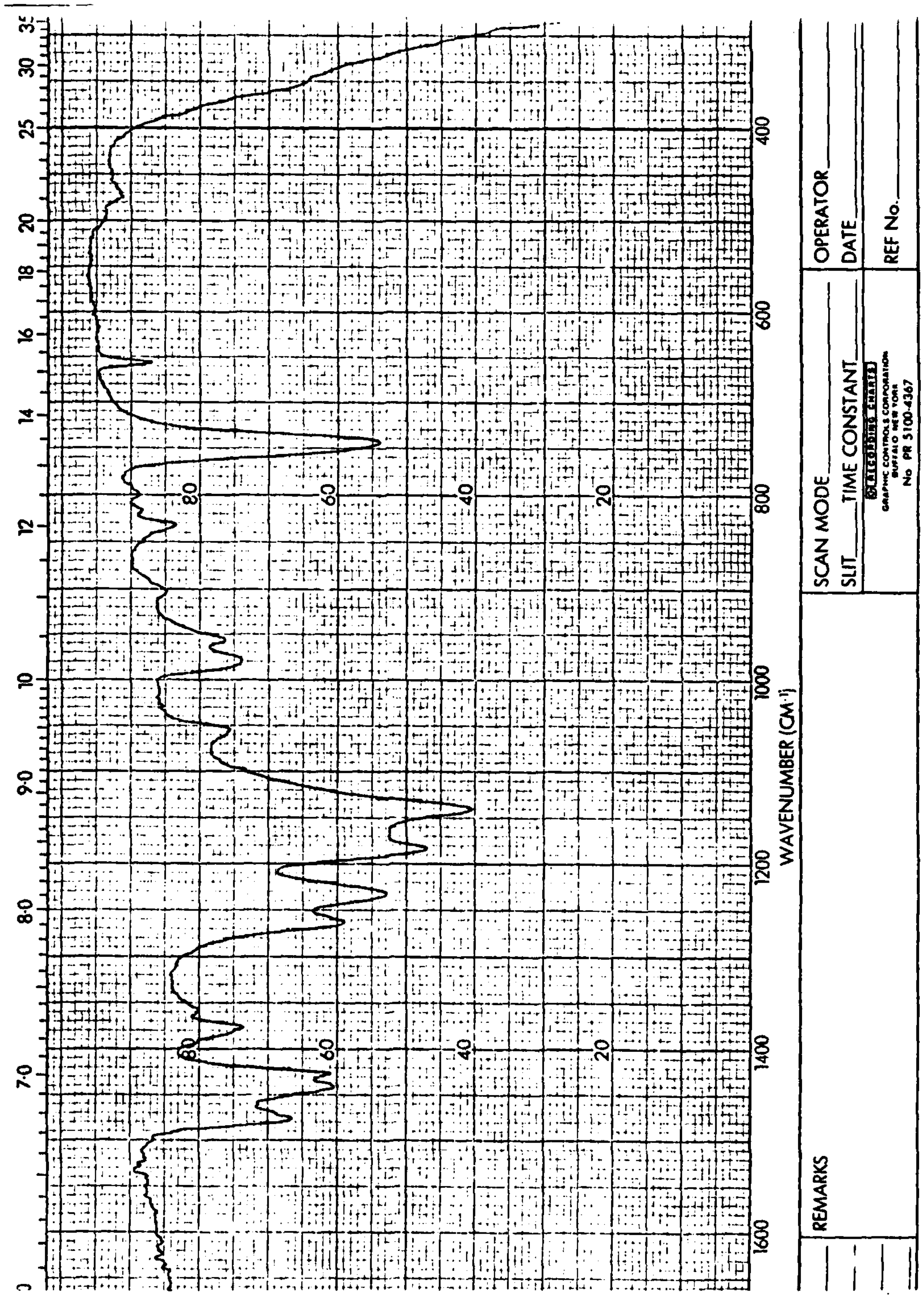
IR reference spectra of methyl methacrylate and Lexan 141 have been included as well as the sample spectra, for comparison purposes.

Physical examination of the "black paint", white paint", and the white lettering on the panel suggests that the material are probably paint of some sort, as suspected. Emission analysis of these portions of the sample is as follows.

*NOTE: The white lettering on the face of the panel appears to have been applied over the black paint.

ANALYST: ______________________________


MICRONS
WAVENUMBER (CM-1)
SOLVENT
CONCENTRATION Cast Film
CELL PATH
REFERENCE
SAMPLE
27449 - plastic panel
ORIGIN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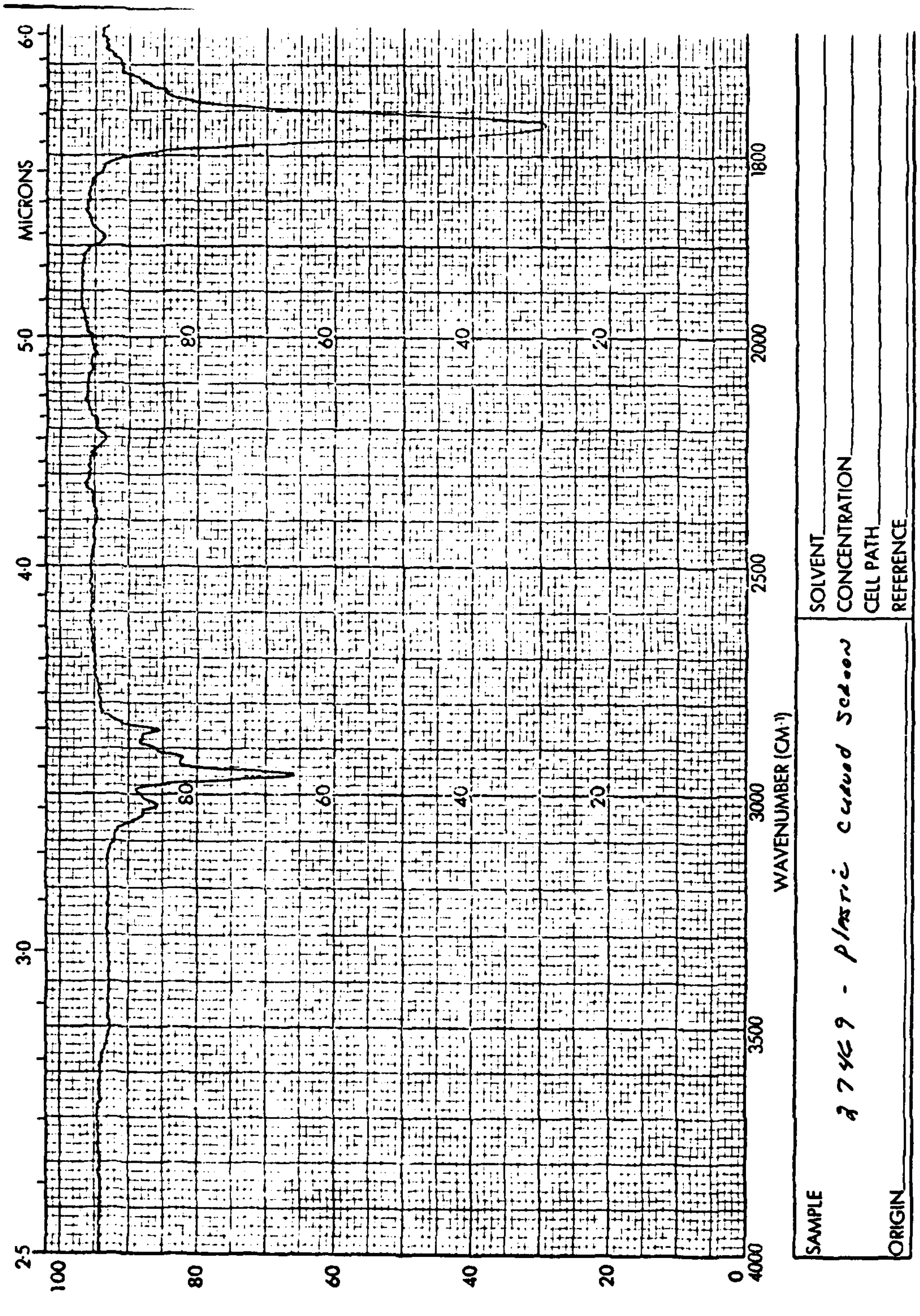
REMARKS
RECORDING CHARTS
GRAPHIC CONTROLS CORPORATION
BUFFALO NEW YORK
No PR 5100-4367



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4·0
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2·5
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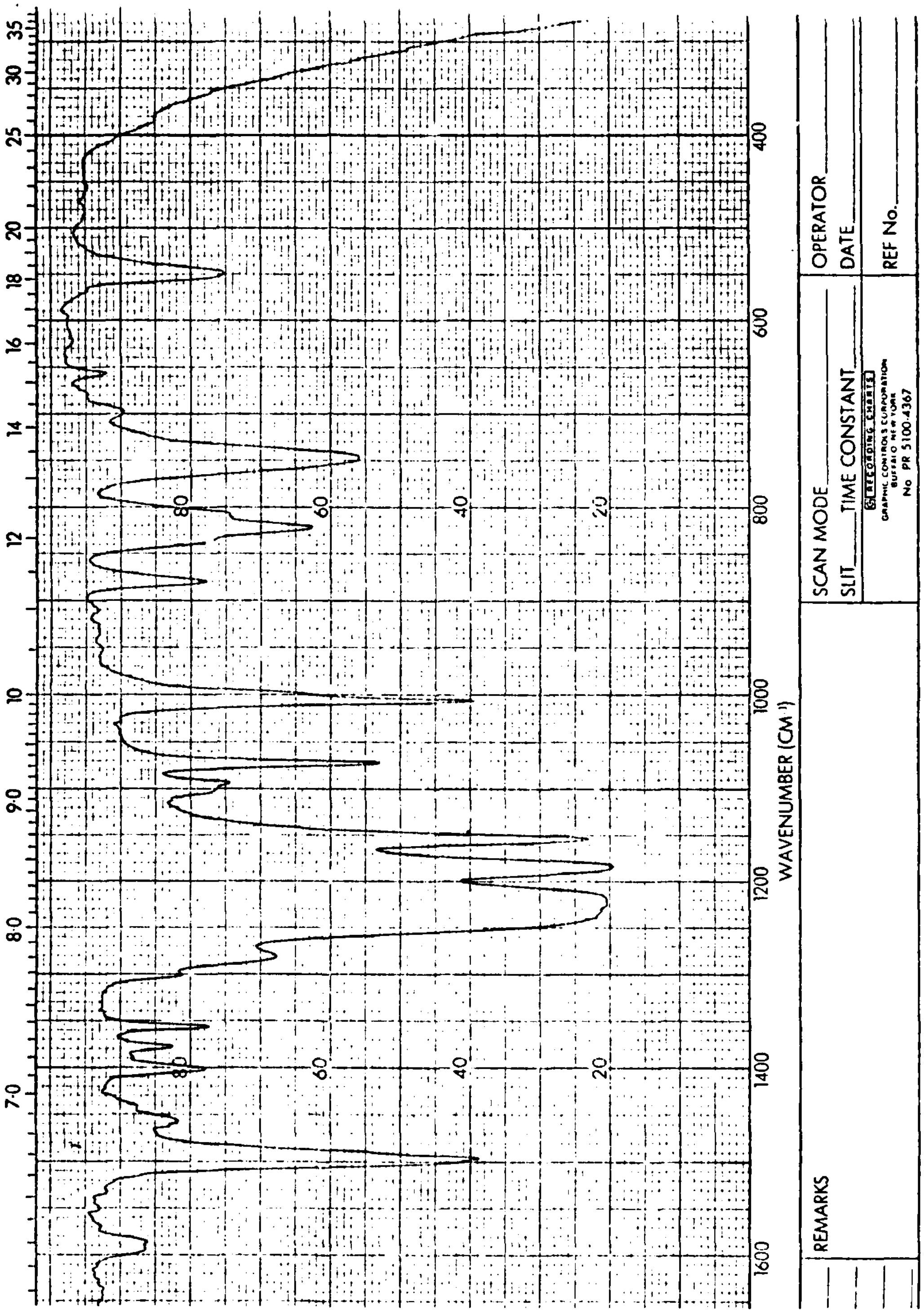
SAMPLE
ORIGIN
SOLVENT
CONCENTRATION
CELL PATH
REFERENCE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TIME CONSTANT
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DATE
REF No.
REMARKS

ANALYSIS REPORT

DATE
31 July 84

MLU NUMBER
27469 - Supplemental

JOB ORDER NUMBER

NOTEBOOK REFERENCE

TECHNICAL SERVICES GROUP
AFWAL/MLU-ACG
WPAFB, OHIO 45433
(513) 253-0282

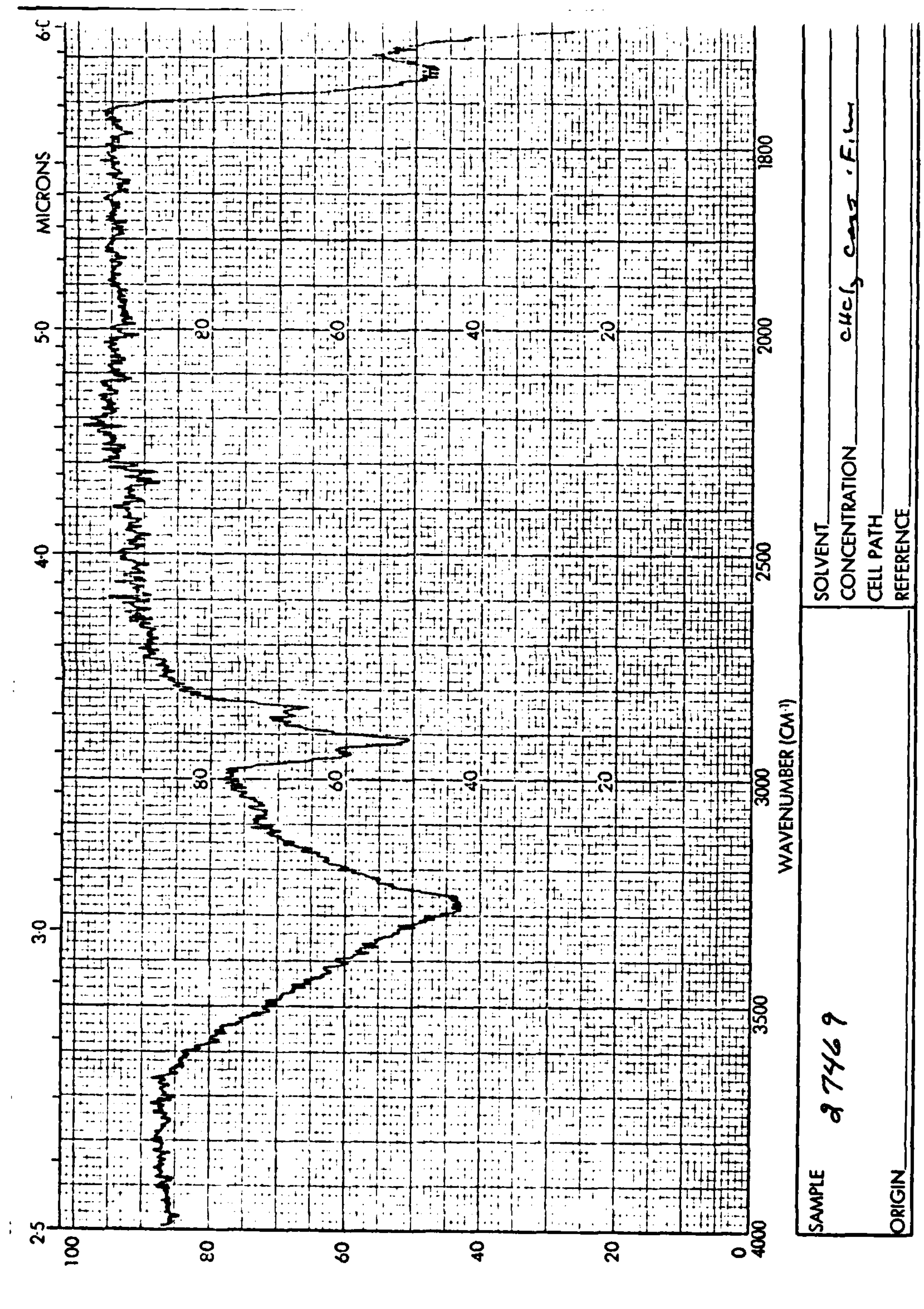
NOTE: This report is supplemented to the analysis report of 18 July 84 on sample MLSA # 27469.

Additional infrared analyses were performed on the black and white "paint" components of sample #27469 (plastic panel). The IR data suggests that the two materials are the same and that they are polyamides. Characteristic absorptions are observed in the spectra at 3280 cm^{-1} (due to N-H stretching) at 1650 cm^{-1}. (Amide I band - due to C=O stretching) and at 1540 cm^{-1} (Amide II band - due to a coupled N-H bending and C-N stretching mode). A search of IR reference spectra failed to yield a match of the samples to known polyamide materials.

C, H, and N elemental analysis confirmed the presence of nitrogen in the molecule.

(sample spectrum included)

ANALYST: ______________________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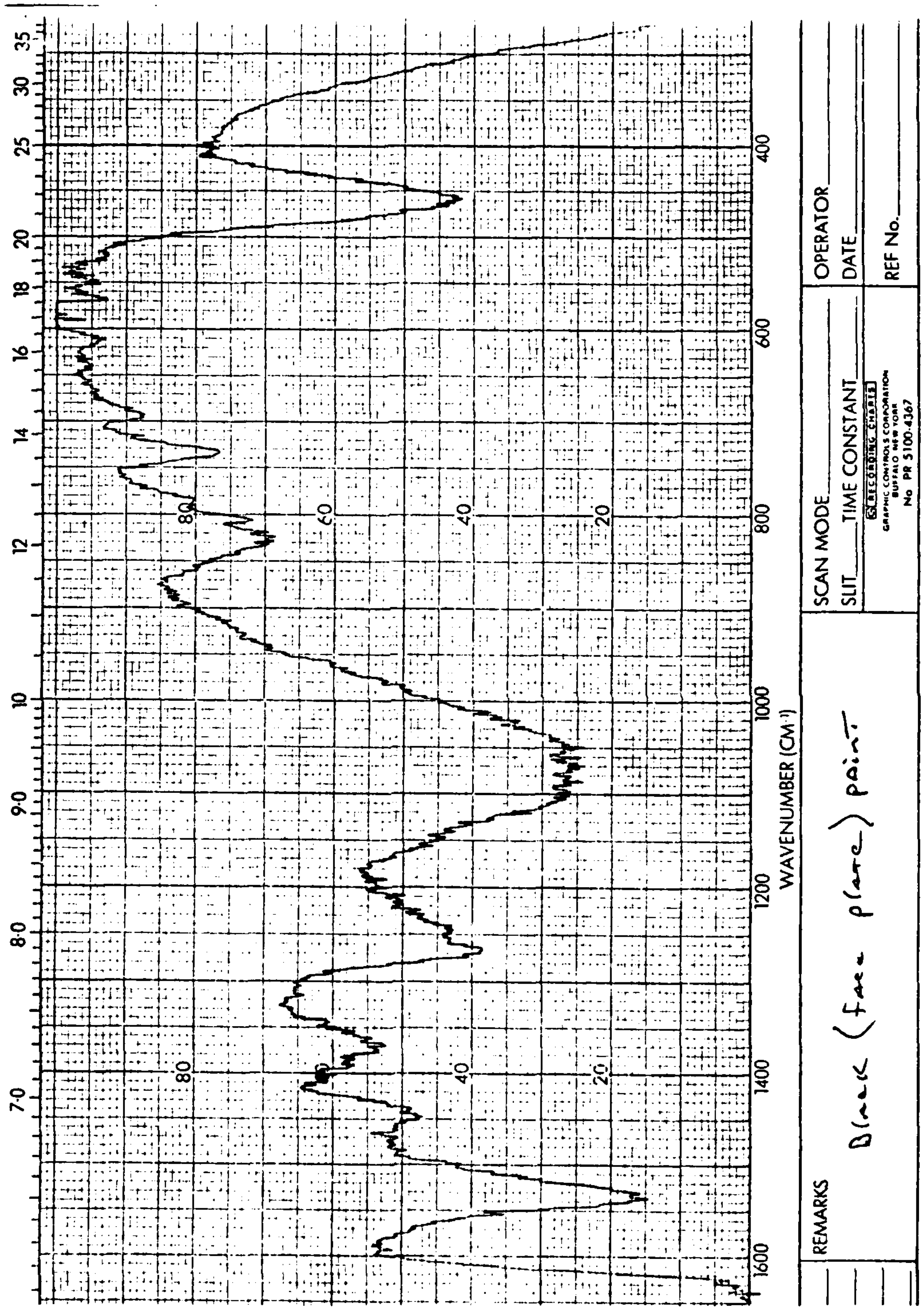
WAVENUMBER (CM-1)
SOLVENT
CONCENTRATION
CELL PATH
REFERENCE
SAMPLE
ORIGIN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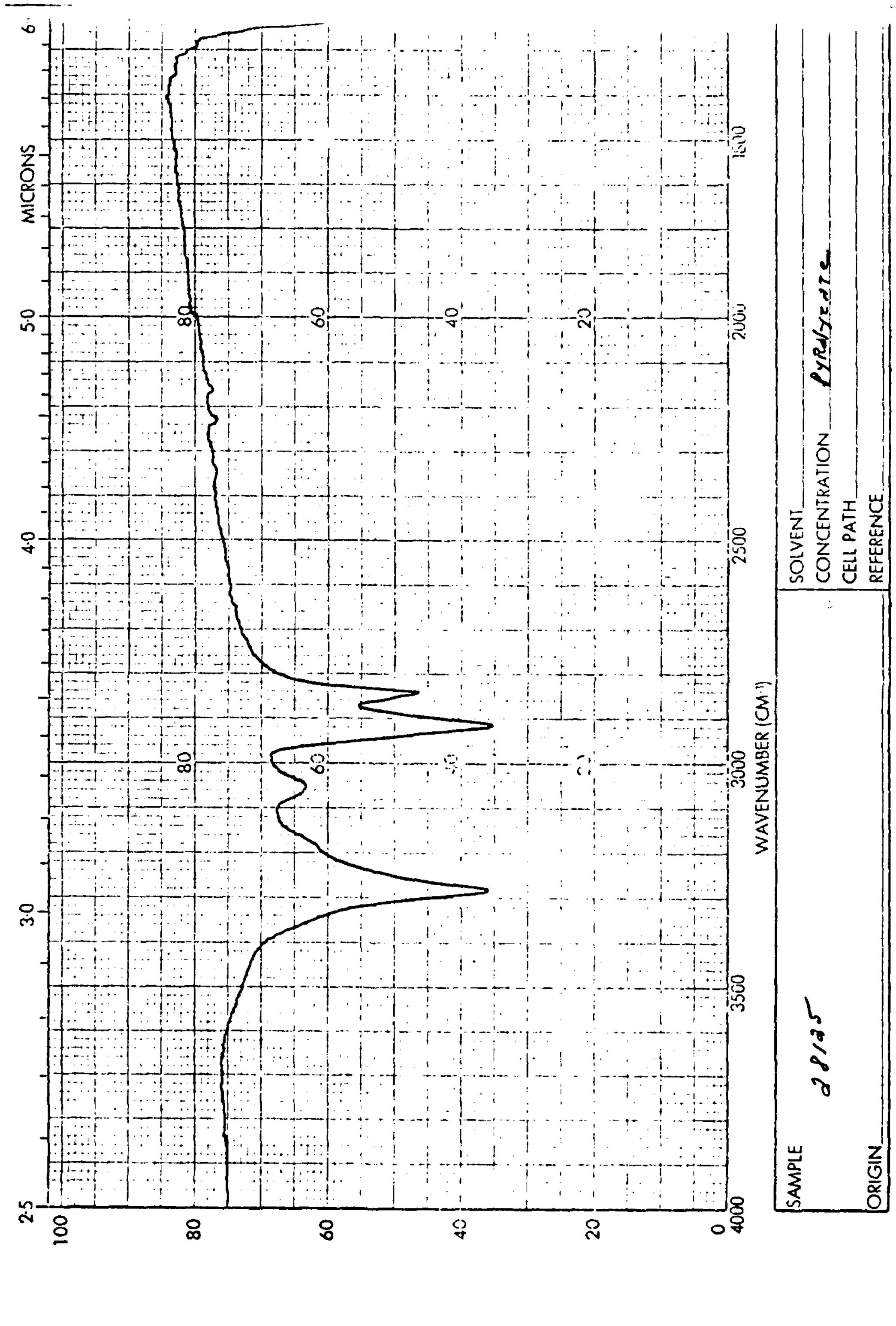
SLIT
TIME CONSTANT
OPERATOR
DATE
REF No.
REMARKS
Black (face plate) paint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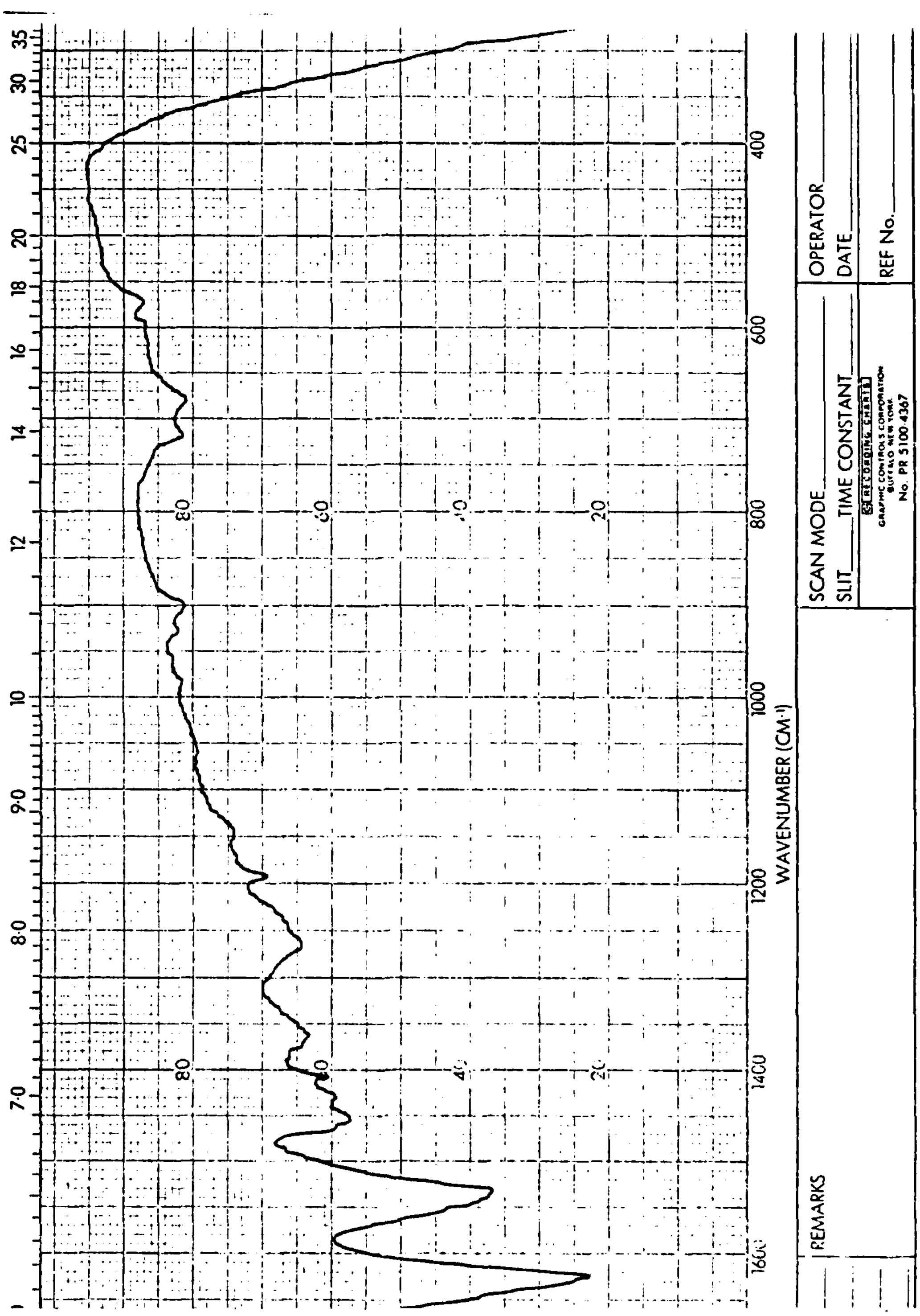
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BUFFALO NEW YORK
No. PR 5100-4367

SADTLER RESEARCH LABORATORIES, INC

COMMERCIAL - INFRARED

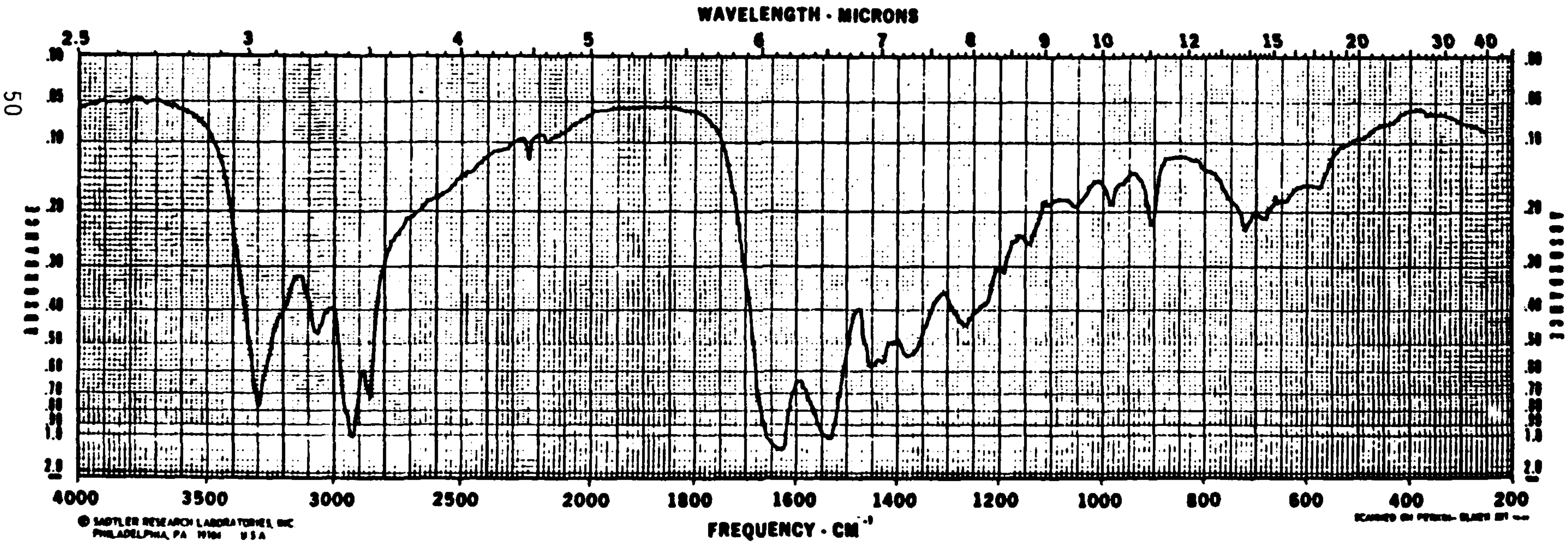
ULTRAMID A 3 NATURAL   NYLON 66

POLYAMIDE (HEXAMETHYLENEDIAMINE/ADIPAMIDE POLYMER)

Source: BASF Colors & Chemicals, Inc.
Film

PYROLYZATES

GRATING SPECTRA



AFWAL/MLSE (Neal R. Ontko 255-5063) 8 August 1984

DESC Teletype Parts Characterization

DESC-SV
Mr. Don Milliken

1. The materials submitted for characterization have been analyzed by groups within AFWAL/MLS as requested.

2. The following information is submitted for your use in future procurements.

3. FSN 5815-00-409-2569, 196094, HEAD, Level-A-1983 MOF

Fe - base	Mn 1.2%
Cr - .47%	Si .35%
W - .69%	V .19%

The iron based alloy contains .86% Carbon and was identified as AISI 0-1. This particular piece has a copper coating over nickel flash on the base metal.

4. FSN 5999-201-4408, Contact, P/N NX1004 is an almost pure copper base alloy.

Cu - base
Pb - 1.0%

5. FSN 5821-00-944-3437, Panel-Radio is best described in the attached report. The panel was characterized as a "plexiglass" material. Hardness readings of 35 to 50 were taken with a hand held "Barcol Impressor". The curved optical "lens" was characterized as a "polycarbonate" and falls in line with a spectroscopy for "Lexan 141". Hardness readings of 10-20 were taken on this piece. Both black and white paint type coatings and a clear coating on the front (face) only were identified as polyamides. The pigments were identified for the white coating as:

Ti - principal (probably titanium dioxide)
Si - 15%
Al - 1.0%

and for the black coating as:

Si - principal (probably silicone dioxide)
Ti - 0.3%

6. The attached report and accompanying photos detail the information provided herein.

NRO

NEAL R. ONTKO
Materials Engineer
Systems Support Division

2 Atchs
1. Analysis of VHF COMM
   Cover Panel
2. Six Photos

AIR FORCE WRIGHT AERONAUTICAL LABORATORIES (AFSC)

WRIGHT-PATTERSON AIR FORCE BASE, OHIO

EVALUATION REPORT

DETERMINATION OF SELECTED PROPERTIES OF TELETYPE PARTS FOR DESC

REPORT NR: AFWAL/MLSA 80-36

DATE: April 1980

PROJECT NR: 24180703

TYPE EVALUATION: Mechanical Properties and Chemical Analysis

MANUFACTURER: Teletype

SPEC NR: N/A

SUBMITTED BY: Defense Electronics Supply Center (DESC)

ITEM SERIAL NR: N/A

WUD NUMBER: 31

I. PURPOSE:

This program was initiated for the Defense Electronics Supply Center (DESC) to determine selected properties of the supplied teletype parts.

II. BACKGROUND:

In January, a DESC representative contacted MLSA requesting support for a DESC sponsored program to determine specific properties for some of their teletype parts. MLSA agreed to perform hardness tests, surface finish tests, and chemical analysis (alloy identification) for the parts provided. These tests were part of a larger program to determine specifications for teletype parts so that DESC could save money procuring by these parts through competitive bidding.

III. SPECIMENS:

The specimens were provided by DESC. They were twelve commonly used (replaced) teletype parts. The parts were identified by a National Stock Number (NSN) and noun. Some parts had more than one type of material in them. In these cases, an attempt was made to identify each material. In some cases, hardness readings and surface finish measurements could not be taken.

IV. TEST PROCEDURES:

Hardness tests were performed using a standard Rockwell hardness tester. All readings are an average over the entire piece. When size or case hardening was a constraint, the specimens were prepared and tested for microhardness on a Sheffield microhardness tester.

A chemical analysis of the parts was performed by Mr James H Muntz of the AFWAL/MLU using spectrometric analysis. The plastics were determined by pyrolysis.

THIS REPORT IS NOT TO BE USED IN WHOLE OR IN PART FOR ADVERTISING OR SALES PROMOTION PURPOSES

ASD FORM APR 65 64 PREVIOUS EDITION OF THIS FORM MAY BE USED. AF-WP-O-MAY 65 2?

Surface finish measurements were taken by the Quality Assurance section of the 4950th AMCQB, using a Profilometer.

V. RESULTS:

The results of all the tests are in Table 1. There are two (2) unidentifiable alloys listed in the results; they are marked with an asterisk. The first was P-6. It had hardness and surface finish characteristics the same as P-5, but the chemistry showed a significant amount of Chromium (.2%). This chromium was consistent throughout the specimen, not just a plating. It could not be determined from our limited data just what significance the Chromium played in the part. The second part was the inner casting of part P-11 (designated P-11-2). The part was so soft that the lowest conventional R_B hardness test failed to give a good reading. The chemistry also failed to show any resemblance to common steel castings. This was probably due to the inordinate amount of copper (18%). After much research and discussion with lab metallurgists, it was thought to be a company alloy not widely recognized outside the teletype industry.

VI. CONCLUSIONS AND RECOMMENDATIONS:

None - data is submitted for analysis by DESC.

TABLE 1

PART #	NOUN	NSN	HARDNESS	SURFACE FINISH (RMS)	ALLOY
P-1	Plate	5815-00-055-6988	R_C=37	8	Nickel Plated SAE #4320
P-2	Drum	5815-00-370-0263	R_C=56	55	SAE #1046
P-3	Lever	5815-00-370-1063	R_C=42	11	SAE #4320
P-4	Toggle	5815-00-370-0818	R_C=39	13	SAE #4320
P-5	Shoe	5815-00-370-1059	R_C=62	3	SAE #1090
P-6	Shoe	5815-00-370-1060	R_C=65	10	Unknown Alloy* .82%C, .34%MN, .18%SI, .2%Cr
P-7	Bracket	5815-00-947-8477	R_C=41	20	SAE #8617H
P-8	Brake Slide	5815-00-709-9427	R_B=75	11	Nickel Plated SAE #1006
P-9	Bracket	5815-00-370-0974	R_B=30	20	Nickel Plated SAE #1006
P-10	Gear	5815-00-909-8859	R_B=55	35	Aluminum Casting AA #F-332
P-11-1	Drum (Outer Steel Shell)	5815-00-409-2523	R_C=50	35	SAE #1048
P-11-2	Drum (Inner Casting)	N/A	No Reading	No Reading	Unknown Alloy* 18.0%Cu, .25%MN, .11%SI 1.12%C
P-12	Dash Pot	5815-00-370-0881	No Reading	60	Zinc Casting SAE 903 (ASTM AG40A)
P-10P	Plastic Gear Teeth	N/A	N/A	N/A	Polyamide "Nylon"
P-11P	Plastic Gear Teeth	N/A	N/A	N/A	Polyamide "Nylon"

* Ferrous Alloy

PREPARED BY:

Richard A. Gassman

CAPTAIN R GASSMAN
Materials Integrity Branch
Systems Support Division

COORDINATION:

C L Harmsworth

C L HARMSWORTH, Technical Manager
for Engineering and Design Data
Materials Integrity Branch
Systems Support Division

PUBLICATION REVIEW

This report has been reviewed and is approved.

T D Cooper

T D COOPER, Chief
Materials Integrity Branch
Systems Support Division

DISTRIBUTION:

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AFWAL/MLSE	A OLEVITCH
AFWAL/MLSS	LT COL SNIDE
DESC	Defense Electronics Supply Center Attn: D Milliken DESC/SV Dayton, Ohio 45444

SYSTEMS SUPPORT DIVISION
AFWAL/MATERIALS LABORATORY
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

EVALUATION REPORT
DETERMINATION OF SELECTED PROPERTIES OF TELETYPE PARTS

REPORT NR: AFWAL/MLS 80-79 DATE: 20 October 1980

PROJECT NR: 24180703 TYPE EVALUATION: Chemical Analysis, and Mechanical Properties

MANUFACTURER: Teletype SPEC NR: N/A

SUBMITTED BY: Defense Electronic Supply Center, Dayton, OH 45444 ITEM SERIAL NR: N/A

WUD Nr. 31

I. PURPOSE:

To determine the chemical composition, hardness number and surface finish of the teletype parts submitted by the Defense Electronic Supply Center (DESC).

II. BACKGROUND:

The Defense Electronic Supply Center is in the process of establishing specifications for Teletype parts, which are purchased from that company. The alloy identification of these parts are unknown by DESC. Therefore, they have requested the assistance of MLSA. This office agreed to perform hardness tests, surface finish and chemical analysis. DESC stated that the monetary savings would be substantial by purchasing these parts through competitive bidding.

III. SPECIMENS:

The specimens were provided by DESC. There were nine metallic and one plastic commonly used (replaceable) teletype parts. The parts were identified by a National Stock Number and Nomenclature. Some parts were made of more than one kind of material. An attempt was made to identify each material.

IV. TEST PROCEDURES:

The hardness test was performed using a standard Rockwell hardness tester. All readings are an average of three or more indentations taken on each part. On parts that were suspected of having plating a sample was mounted and inspected under a microscope.

The chemical analysis of the parts was accomplished by personnel of AFWAL/MLLJ, using spectrometric analysis. The analysis of the plastic was made by pryolysis.

The surface finish measurements were made by the Quality Assurance Section

1

of the 4950th, AMCQB, using a prolifometer.

V. RESULTS:

The results of all tests are given in Table I. There are several alloys in Table I, that do not show a hardness number or a surface finish measurement. The omission is because the part was too small or had an irregular shape. The chemistry of these parts was matched with the alloy designation contained in the Metals Handbook and other sources. The analysis of the plastic is a close match to polyethylene. None of the parts were plated.

VI. CONCLUSIONS AND RECOMMENDATIONS:

None, the data is submitted for use by the Defense Electronic Supply Center.

COORDINATION:

Clayton L Harmsworth

CLAYTON L HARMSWORTH, AFWAL/MLSA

PREPARED BY:

Alton W. Brisbane

ALTON W BRISBANE, AFWAL/MLSA

PUBLICATION REVIEW

This report has been reviewed and is approved.

Clayton L Harmsworth

CLAYTON L HARMSWORTH, ACTING CHIEF
Materials Integrity Branch
Systems Support Division

DISTRIBUTION

AFWAL/MLS (Mr Cooper)
MLS (Mr Johnson)
MLSA (B Cohen)
(C Harmsworth)
(A Brisbane)
TST

Defense Electronic Supply Center
ATTN: D Milliken/DESC/SV
Dayton, OH 45444

AFWAL/MLS 80-79

TABLE I

PART NR.	PART NAME	NATIONAL STOCK NUMBER	HARDNESS	SURFACE FINISH (RMS)	ALLOY DESIGNATION
354	Lever	5815-00-370-0939	R_C 42.5	13	SAE 8627
355	Plate	5815-00-524-3408	R_B 90	18	7075 Aluminum Alloy
355-A		5815-00-524-3402	R_C 29		SAE 1074
356	Bar	5815-00-679-8548	R_C 38.7	29	SAE 8627
357	Bracket	5815-00-370-1488	R_B 79.4	23	SAE 1078
358	Follower	5815-00-409-4055	R_C 61.5	70	AISI A-2, Air Harden Tool Steel
359	Hammer	5815-00-071-9030	R_C 59		AISI 0-1, Oil Harden Tool Steel
359-S		5815-00-071-9030			SAE 1095
360-TK	Lever	5815-00-370-0992	R_B 91	10	SAE 4815
360-TN		5815-00-370-0992			SAE 8620
361-TK	Armature	5815-00-066-4393	R_B 70	125	Ingot Iron-Open Hearth Comm. Pure 99.7% Iron
361-Tk	Armature	5815-00-066-4393			Beryllium Copper
361	Armature	5815-00-066-4393			Architectural Bronze
362	Lever	5815-00-571-0133	R_C42.5	28	SAE 4320
363	Plastic Disc				Spectra-Indicate a Close Match to Polyethylene

NOTE: TK=Thick part, TN=thin part, and S=spring

AFWAL/MLS 80-79

☆U.S.Government Printing Office: 1986 — 646-067/40640

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